*A star (*) indicates that the Abstract deals with Apparatus and Instruments.*

## NOVEMBER, 1938.

# GENERAL PHYSICS.

### ADSORPTION (see Surface Properties).

### ATOMIC AND MOLECULAR STRUCTURE.

**4270. Structure of Matter. Part I. G. Fournier.** *J. de Physique et le Radium*, 9. *pp.* 273–281, *July*, 1938.—Three-dimensional Euclidean space is divided into elements forming the domain of action of the particles of matter. Space is thus filled with matter and a geometrical framework constructed to define electron paths in atoms and in electron streams. H. G. C.

**4271. Composition of Matter. R. Grégoire.** *R.G.E.* 44. *pp.* 81–89, *July* 16, 1938.—Reviews the modern theories regarding the structure of the atom, the nature of isotopes and the properties of radioactive elements, leading up to a discussion of the mechanism of transmutation and a verification of the law of Lavoisier. E. O. T.

**4272. Coulomb Energy of Light Nuclei. H. A. Bethe.** *Phys. Rev.* 54. *pp.* 436–439, *Sept.* 15, 1938.—The Coulomb energy is calculated by determining the nuclear radius so that the energy difference between $N^{13}$ and $C^{13}$ agrees with observation. Two different assumptions are investigated: (*a*) that the nuclear radius is simply proportional to the cube root of the number of particles, (*b*) that the wave function of the last neutron or proton extends beyond the surface of the residual nucleus by an amount determined by its binding energy. The latter assumption accounts very well for the irregularities of the positron energies in the series $C^{11}N^{13}O^{15}F^{17}$, and agrees quantitatively with observation within 0·15 milli-mass-units. Theoretically and experimentally, the actual Coulomb energy should lie between the results of (*a*) and (*b*). Application of these considerations to unknown nuclei shows that $C^{10}$ and $O^{14}$ are highly stable, $Be^{6}$ certainly and $B^{9}$ almost certainly unstable, while the stability of $B^{8}$ and $N^{12}$ is doubtful. AUTHOR.

***4273. Separation of Isotopes for Investigation of Nuclear Transformations. E. L. Yates.** *Roy. Soc., Proc.* 168A. *pp.* 148–158, *Oct.* 10, 1938.—A mass spectrograph of simple design has been used to prepare deposits containing a few micrograms of the separated isotopes of Li, B and C. In the case of Li, a filament type ion source was employed, while the B and C ions were produced in a l.v. capillary arc running in $BF_3$ and in a mixture of $CD_4$ and He respectively. On examination in artificial disintegration experiments, the samples were found to be of high purity. AUTHOR.

**4274. Extension of Periodic Table and Elements beyond Uranium. P. Ray.** *Science and Culture*, 4. *pp.* 167–171, *Sept.*, 1938.—A brief account of the results of bombardment of the elements with α-particles, neutrons, protons and deuterons; and a somewhat more detailed summary of the results of Meitner, Hahn and Strassmann with uranium [see Abstract 3314 (1937)]. C. A. S.

**4275. Hexacoordination in Telluric Acid, and in Molybdates and Tungstates in Solution. J. Gupta.** *Indian Journ. Phys.* 12. *pp.* 223–232, *Aug.*, 1938.—Following a previous communication on the

subject (*Nature*, 140. *p.* 685, 1937), telluric acid and several molybdates and tungstates have been examined by their Raman spectra in the crystalline state and in aqueous solutions of definite H-ion concentration. Theoretical and experimental evidence for the author's previous suggestion that in aqueous solutions, the normal molybdate and tungstate ions are present, like telluric acid, as dihydrated octahedral units, have been adduced. Extra lines recorded by other workers in solutions have been shown to be not due to vibrations of the normal molybdate or tungstate ions, but some of them are due to isopolycomplexes present in such solutions. AUTHOR.

**4276. Valency and Covalency of Ruthenium in the Blue Chloride Solution. L. W. N. Godward and W. Wardlaw.** *Chem. Soc., J. pp.* 1422–1424, *Sept.*, 1938.—The blue solution resulting from the reduction of ruthenium trichloride has been reinvestigated. Four well-defined, new coordination compounds have been isolated by its interaction with certain amines under suitable conditions. In these compounds the metal is shown to be bivalent. As expected on theoretical grounds, they possess zero magnetic moment. AUTHORS.

**4277. Maximum Valency and Atomic Structure. B. Ormont.** *Acta Physicochimica*, 8. 6. *pp.* 811–847, 1938. *In German.*—The question of chemical compound formation is considered in a general manner from the point of view of stable electronic configurations and stable nuclear configurations, and the unsatisfactory character of all the valency theories so far advanced is emphasised. In particular, views are advanced as to the influence of electrons not formally involved in chemical links upon the valency angles in compounds. Further experimental investigations of the structure of compounds in which the valency is less than the maximum are considered to be desirable. [See Abstract 1416 (1937).] L. A. W.

**4278. Deformation of Molecules in Condensed Phases and the Hydrogen Bond. E. Bauer and M. Magat.** *J. de Physique et le Radium*, 9. *pp.* 319–330, *Aug.*, 1938.—It is shown that the electrostatic perturbations of molecules by their neighbours permit the qualitative and in some cases quantitative explanation of the behaviour of the — OH group in different states of matter. The hypothesis of a homopolar H-bond is considered to be unnecessary, and the conception of a polar union is found to afford far better explanations of the frequency variations (*e.g.*, Raman and infra-red spectra) of the — OH radical as a function of temperature and physical state, and of relationship between solute and solvent. H. H. Ho.

**4279. Estimation of Atomic Distances in Halides $AX_3$ and $AX_4$ by means of Electron Diffraction. O. Hassel and A. Sandbo.** *Zeits. f. phys. Chem.* 41. *Abt.B.* 1. *pp.* 75–85, 1938.—Continuing earlier work [see Abstract 2652 (1938)], electron diffraction is used to investigate the molecular structure of halides of the fourth and fifth groups of the periodic table. The investigation gives new values for the distances of atomic separation, but these do not necessitate any fundamental alteration in the conception of molecular structure based upon the earlier work of Brockway and Jenkins [see Abstract 5344 (1936)]. The difference between the sum of the radii and the atomic distances in the Si compounds is striking, particularly with $SiBr_4$ and $SiI_4$. With regard to the problem of valency angles in the case of $AX_3$ molecules, it appears to be certain that of the corresponding As and Sb halides the As compound exhibits the larger

angle. Further it seems probable that for halides of the same element the angle increases with increasing atomic weight of the halogen. A. G. Q.

**4280. Scattering of X-Rays by Liquids, particularly Tertiary Aliphatic Amines. R. N. Bapat.** *Zeits. f. Physik*, 110. 5–6. *pp.* 389–392, 1938.—The scattering of X-rays by $(C_2H_5)_3N$, n-$(C_3H_7)_3$·N, n-$(C_4H_9)_3$·N, iso-$(C_4H_9)_3$·N, n-$(C_5H_{11})_3$·N, iso-$(C_5H_{11})_3$·N, iso-$(C_5H_{11})NH_2$ and iso-$(C_5H_{11})_2NH$ has been observed using a Shearer X-ray tube with a Cu target. The amine was placed in a circular hole in a glass plate sealed on either side with mica. From the position of the interference rings using the Bragg equation, " d " is calculated for each liquid and it is shown that the branched chain of the tertiary iso- compounds increases the linear cross-section of the molecule only when the hydrocarbon chain is short. F. J. L.

**4281. Complexity of $P_2O_5$. A. Smits, J. A. A. Ketelaar and J. L. Meijering.** *Zeits. f. phys. Chem.* 41. *Abt.B.* 2. *pp.* 87–97, 1938.—Vapour pressure measurements of the metastable form of $P_2O_5$ were carried out in glass and quartz apparatus in the temperature range of 260°–360° C. The vapour pressure is 0·4 to 1·7 cm.Hg. higher when determined in quartz apparatus. The vapour is unsaturated with respect to the metastable form but supersaturated with respect to the stable form : it also varies quite distinctly with regard to time. This variation is due to the transformation of the vapour on the walls, which transformation is catalysed by the walls, the glass having the greater catalytic effect. Vapour density determinations were made showing differences in the degree of association of the various forms. G. G.

**4282. Complexity of Aluminium Chloride. A. Smits, J. L. Meijering.** *Zeits. f. phys. Chem.* 41. *Abt.B.* 2. *pp.* 98–111, 1938.—An abnormal form of $Al_2Cl_6$ is obtained by the partial sublimation of the pure, very dry, salt. It shows an abnormally low vapour pressure and it is not stable, slowly changing to the ordinary form. This is explained by regarding the solid phase of $Al_2Cl_6$ as being composed of at least two pseudo-components. Sublimation and vapour pressure curves are obtained from which the position of the triple point can be found. Vapour-density determinations give the molecular weight as 271, while the theoretical value for $Al_2Cl_6$ is 267. G. G.

*See also* Abstracts 4301, 4450, 4464, 4530, 4660.

## COLLOIDS.

**4283. Nuclear Gold Sols. Part I. Determination of Particle Size. F. L. Usher.** *Faraday Soc., Trans.* 34. *pp.* 1230–1233, *Oct.*, 1938.—A colorimetric method of determining particle size in nuclear gold sols is described, in which the colour scale is standardised by a sol whose particle size has been established by an independent method. The method is rapid in operation and suitable for routine measurements. Its accuracy is substantially that of the measurement used for standardising the colour scale. The colour of gold sols grown under proper conditions is, within the limits of accuracy of the measurements, strictly a function of particle size, and is independent of the reducing agent used when the latter is hydrazine hydrate, hydroxylamine hydrochloride, or hydrogen peroxide. AUTHOR.

**4284. Colour and Nature of Solutions of Na in Liquid $NH_3$. F. Krüger.** *Ann. d. Physik*, 33. 3. *pp.* 265–284, *Oct.*, 1938.—The following evidence is given in support of the view that solutions of Na in liquid $NH_3$ are colloidal. Calculation of absorption spectrum by the Mie theory,

making simplifying assumptions and using uncertain values for the optical constants of Na, gives rough agreement with experiment. Ultramicroscopic investigations, although beset with experimental difficulties, reveal colloidal particles. It is found possible (by means of so-called " ultracella " filters) to filter off the blue part of the solutions, the filtrate having a much reduced electrical conductivity. It also appears possible to increase the life of the solutions by suitable protective colloids. L. A. W.

**4285. Ferromagnetic Gels. T. Katsurai and K. Yamasaki.** *Kolloid Zeits.* 84. *pp.* 311–314, *Sept.*, 1938.—Ferromagnetic gels were obtained by rubbing together $FeCl_3 \cdot 6H_2O$ and $Na_2SO_4 \cdot 10H_2O$, $MgSO_4 \cdot 7H_2O$, $MnSO_4 \cdot 5H_2O$, $NiSO_4 \cdot 7H_2O$, $CoSO_4 \cdot 7H_2O$, $ZnSO_4 \cdot 7H_2O$, $CuSO_4 \cdot 5H_2O$, $3CdSO_4 \cdot 8H_2O$, $HgSO_4$, and $(UO_2)SO_4 \cdot 3H_2O$, respectively. Treatment in an autoclave at 180° broke down the gels into two phases, the precipitate resembling neither haematite nor magnetite. A demonstration experiment which shows the difference in magnetic properties of iron hydroxides obtained in different ways is described. The colours of solutions of ferrous and ferric salts and their mixtures have been investigated photometrically. A. J. M.

**4286. Thixotropic and Plastic Behaviour of Suspensions of Barium Sulphate with Clay. B. Tamamushi and Y. Sekiguchi.** *Chem. Soc. Japan, Bull.* 13. *pp.* 556–565, *Aug.*, 1938. *In English.*—Non-thixotropic suspensions of $BaSO_4$ become thixotropic on adding certain amounts of a sodium-clay formed from a natural hydrogen-clay. The plasticity of the suspensions of $BaSO_4$ increases when the sodium-clay is added. The correlation among thixotropy, loose packing of particles (large volume of sedimentation), and isothermal plasticity, which is now generally accepted, is evident also in the systems under investigation. A characteristic influence of the particle size of $BaSO_4$ on the thixotropy and plasticity of the systems is mentioned. AUTHORS.

**4287. Water-in-Oil Emulsions. Part I. R. C. Pink.** *Chem. Soc., J. pp.* 1252–1254, *Sept.*, 1938.—Anhydrous and hydrated magnesium oleate have been prepared and examined. It has been shown that addition of small amounts of water to solutions of the anhydrous soap in benzene causes its precipitation in an insoluble form containing water. Such systems are not true emulsions, although appearing to be so. The results indicate that in the inversion of oil-in-water emulsions with magnesium chloride the magnesium oleate formed does not dissolve in the oil phase. AUTHOR.

**4288. Conductivity Anomalies in Molecular and Colloidal Disperse Solutions. K. Hoffmann.** *Kolloid Zeits.* 84. *pp.* 344–357, *Sept.*, 1938.—This very comprehensive paper deals with conductivity anomalies in 3 sections. Section (1) is devoted to the theory of conductivity anomalies and considers (*a*) anomalies based on interionic forces; (*b*) dissociation tension effects; (*c*) dipole effects; (*d*) influence of the non-homogeneity of the medium. Section (2) records experimental investigations and results for strong and weak electrolytes with respect to (*a*) field effect and (*b*) frequency effect. Section (3) contains experimental data for colloidal systems with respect to the field and frequency effects. The paper includes 23 diagrams and a Bibliography of 61 references. H. H. Ho.

**4289. Colloidal Structure of Rubber in Solution. S. D. Gehman and J. E. Field.** *Indust. and Engin. Chem.* 30. *pp.* 1031–1036, *Sept.*, 1938.—The colloidal changes caused by the addition of precipitants to rubber solutions have been observed by measurements of viscosity and of

the intensity and depolarisation of the transversely scattered light, as a means of securing information about the colloidal structure of rubber solutions. The light scattering measurements show that colloidal changes occur which are not apparent from the viscosity data. This is explained by the fact that the light scattering depends upon the geometry of the structure and the viscosity upon the potential energy in the structure. The results are considered to be further evidence that, in rubber solutions, the rubber molecules exist in clusters or groups, the size, shape, and "interlocking" of which depend upon the molecular forces in the solution.

H. H. Ho.

**4290. Optical and Dimensional Changes in Freezing and Melting of Rubber. W. H. Smith and C. P. Saylor.** *Bureau of Standards, J. of Research*, 21. *pp.* 257–268, *Sept.*, 1938.—Microtome sections of frozen rubber were prepared and examined at controlled temperatures under a polarising microscope. The melting behaviour of both strained and unstrained sections of unvulcanised specimens, partially-vulcanised specimens and thin films was investigated. The effect of stress on the freezing of rubber was also studied, and the crystalline structure of frozen and stretched rubber is discussed. S. W.

**4291. Crystallisation in Stretched Rubber. P. A. Thiessen and W. Wittstadt.** *Zeits. f. phys. Chem.* 41. *Abt.B.* 1. *pp.* 33–58, 1938.—The conclusions found for rubber under pressure are found also to be valid for stretched rubber. [See Abstract 3454 (1938).] D. R. H.

*See also* Abstracts 4462, 4641.

## CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

**4292. Energy States of Valency Electrons in Metals. M. Satô.** *Tohoku Univ., Sci. Reports*, 27. *pp.* 137–154, *July*, 1938. *In English.*—The selectivity of photoelectron transitions in the surface of Zn crystal was closely examined, and found to have an intimate relation with the direction of the oscillating electric vector of the exciting light. Further, applying the results obtained from the electrode potentials of the surfaces of Zn-single crystals, it was inferred that the selection rule, $\Delta l = \pm 1$, is explicable from the fact that the stability of orbital motion of the electron depends on the mutual orientation of the orbital plane and the electric vector of the exciting light. On the basis of this conception it was concluded that the orbital planes of $p$ and $d$ electrons in the energy levels, $E_2$ and $E_3$, in the surface layers of zinc crystals are perpendicular and parallel, respectively, to the axis [0001] of the crystal of this metal. [See also Abstract 1668 (1938).] Author.

**4293. Cubical Atom Domains in the Crystal Structure of Metals. R. Reinicke.** *Zeits. f. Instrumentenk.* 58. *pp.* 331–339, *Aug.*, 1938.—The use of spherical atoms in constructing models of the crystal structure of metals is criticised. It is suggested that the anomalies in such models can be avoided if cubical domains of action for the atoms are assumed. This procedure leads necessarily to the assumption of directed forces between the atoms. W. S. S.

**4294. Statistical Theory of Superlattices with Long-Range Interaction. Parts I and II. J. S. Wang.** *Roy. Soc., Proc.* 168A. *pp.* 56–77, *Oct.* 10, 1938.—In Part I Bethe's theory of order-disorder in superlattices is extended to cover the case of long-range interactions. The theory is applicable to any interaction energy of the form $V(r)$ subject to

the condition $\int_0^\infty V(r)r^2dr$ = finite, and to a general class of lattice structures which include the three lattices of the cubic system. In Part II the general statistical theory is applied to the simple cubic lattice and the body-centred cubic lattice. It is shown that the assumption of an inverse power law for the interaction energy alters the calculated configurational energy in the direction required to make the agreement with experiment better than the assumption of interaction between nearest neighbours only, but the shift is not great enough to remove the discrepancy between theory and experiment completely. AUTHOR.

**4295. X-Ray Study of Ag-Zn Alloys. E. A. Owen and I. G. Edmunds.** *Inst. of Metals, J.* 63. [24 *pp.*], 1938. *Advance Copy.*—The phase boundaries in the Ag-Zn system below the temperatures of the $\beta$ transformation have been determined by the X-ray method. All the boundaries in this region of the accepted equilibrium diagram require modification. The $(\beta + \zeta)$ phase field is found to be very narrow; its lower boundary reaches a minimum value at about 262° C. for an alloy containing about 65% Ag by weight. This temperature is lower than either of the $\beta$-transformation temperatures in the adjacent duplex regions. A survey is made of the positions of the phase boundaries in the Ag-Zn equilibrium diagram as determined by X-ray analysis. Attention is paid to the $\zeta$ phase, which is found to possess a close-packed hexagonal structure with 54 atoms to the unit hexagonal cell. AUTHORS.

**4296. Structure of Electrolytic Lead Deposited from Nitrate Solutions. S. Yamamori and S. Yoshimoto.** *Kyoto Coll. Sci., Mem.* 21. *pp.* 75–84, *July*, 1938. *In English.*—The arrangement of the micro-crystals in electrolytic specimens of lead, deposited from nitrate solutions was examined with X-rays by the Laue method. From the diffraction patterns obtained, it was confirmed that the micro-crystals of lead have a tendency to be electrolytically deposited in a fibrous way, with one of their [211] axes arranged parallel to a definite common direction, as was the case in the experiments previously made by other investigators with various electrolytes of different chemical composition. The present examination has shown, however, that in certain respects, conclusions drawn from previous experiments must be reconsidered; *e.g.*, the direction of the maximum growth of deposited lead and the relative orientation of the micro-crystals in the specimen. AUTHORS.

**4297. Submicroscopic Twinning in Metals. F. Kirchner and H. Cramer.** *Ann. d. Physik*, 33. 2. *pp.* 138–142, *Sept.*, 1938.—Irregular interferences in electron diffraction patterns are attributed to the existence of sub-microscopic twinning in the metal specimen, and on this foundation an investigation of the occurrence of twinning in metal films is carried out. Special attention is paid to the case of Ag condensed from the vapour on to heated rock-salt, and it is shown that with a mean Ag film thickness of 0·8 m$\mu$ no signs of twinning are observed. Twinning begins at about 2 m$\mu$ and it is well developed when the average film thickness is 20 m$\mu$. Finally, the authors put forward an explanation of the processes which occur during the growth of metal films. A. G. Q.

**4298. Polymorphic Transitions in Metallic Halides. R. B. Jacobs.** *Phys. Rev.* 54. *pp.* 468–474, *Sept.* 15, 1938.—An X-ray powder analysis of RbI made at 4500 kg./cm$^2$. pressure and room-temperature shows the crystal form of RbI to be body-centred cubic under these conditions. The lattice constant is $4{\cdot}33_5$ Å. The volume change from the face-centred lattice, which is stable below 4000 atm., is 0·037 cm$^3$. per gm.

This is about 0·009 cm³. per gm. greater than Bridgman's piston displacement value and the difference may be significant. With the exception of the fluorides, all of the Rb and K halides undergo polymorphic transformations under pressure, which in the light of the present knowledge of RbI are assumed to be of the face-centred to body-centred type. The method of Born and Mayer is used to calculate the lattice constants for both face- and body-centred types of each halide at the experimentally known temperature and pressure of equilibrium. From these the volume changes of the transformation are computed. They are found to agree quantitatively with the experimental values. Theoretical values for the transition pressure are also given. These are confirmed by experiment only in a qualitative manner, but the method may be used to explain, for instance, the non-occurrence of transitions in the Na halides up to 50,000 atm. Similar calculations are made for AgI, the crystal form of which has been previously shown by the author to be face-centred cubic at pressures beyond 3000 kg./cm². AUTHOR.

**4299. Order Versus Disorder in Ternary Structures Including Certain Spinels. F. C. Blake.** *J. Chem. Phys.* 6. *pp.* 630–635, *Oct.*, 1938.—The doubling process as the second alternative suggested by M. v. Laue for mix-crystals is followed through in the case of lithium ferrite and it is shown in that case that all superlattice lines disappear when the lattice edge is eight times as large as the small disordered lattice found by Posnjak and Barth. It is shown that for this large (33 Å) lattice the *simple* space group, $O_1^h$, gives only face-centred lines on the powder photograph. The disappearance of the superlattice lines for this lattice may be said to be due to the coherence of the X-rays that cause the destructive interference involved. AUTHOR.

**4300. Space-Group and Atomic Arrangements in Phloroglucine Dihydrate. K. Banerjee and R. Ahmad.** *Indian Journ. Phys.* 12. *pp.* 249–258, *Aug.*, 1938.—An analysis of phloroglucine dihydrate by X-rays is described. The axial lengths are $a_0 = 6{\cdot}80$, $b_0 = 8{\cdot}103$ and $c_0 = 13{\cdot}70$ Å. The *okl* planes are absent when $k + l$ is odd and *hol* planes are absent when $h + l$ is odd. So the space-group is $D_{21}^{12}$ Pnnm. The density of the crystal is found to be 1·394 gm./cm³., hence there are 4 molecules per unit cell. Molecular orientation in the crystal lattice is determined from considerations of magnetic anisotropy and space-group. AUTHORS.

**4301. Structure of the Insulin Molecule. D. M. Wrinch and I. Langmuir.** *Am. Chem. Soc., J.* 60. *pp.* 2247–2255, *Sept.*, 1938.—Crowfoot's data on X-ray reflections from insulin crystals [see Abstract 938 (1938)] as summarised in a set of Patterson-Harker vector maps, are found to correspond in great detail to the $C_2$ polyhedral structure predicted for the insulin molecule on the basis of the cyclol theory. The features of the insulin molecule confirmed by the X-ray data include: (1) six high density points at the corners of an octahedron of side 29·4 Å, which is the size given by the cyclol theory; (2) low density regions near the centres of the 44 lacunæ in the cyclol fabric that are located in definite positions in the edges and faces of the polyhedron; (3) a comparative hollow at the molecular centre, *i.e.*, a cage structure; (4) three Zn atoms per molecule on lines connecting molecular centres (except along the *z*-axis) and low and high density groups attached to these Zn atoms outside the $C_2$ structure. AUTHORS.

**4302. Structure of Tricyanobromomethane. W. Fensch and G. Wagner.** *Zeits. f. phys. Chem.* 41. *Abt.B.* 1. *pp.* 1–14, 1938.—Single crystals of the above compound are obtained by sublimation. An X-ray analysis gives the following results. The crystals are orthorhombic with $a = 6{\cdot}05$, $b = 11{\cdot}33$, $c = 17{\cdot}17$ Å; 8 mols. of $BrC(CN)_3$ per unit cell; density $= 1{\cdot}8$; space group $= D_{2h}^{11}$. The positions of the Br atoms are given by the co-ordinates $x = 0{\cdot}197$, $y = 0{\cdot}229$, $z = 0{\cdot}181$. It is probable that the group $C(CN)_3$ has the symmetry $C_s$. On the basis of these results the author puts forward a structure for the molecule $BrC(CN)_3$. J. I.

**4303. Structure of Cyclohexane and Derivatives. O. Hassel and A. M. Sommerfeldt.** *Zeits. f. phys. Chem.* 40. *Abt.B.* 5. *pp.* 391–395, 1938.—The structure of cyclohexane, which has a cubic lattice, is discussed and it is shown that at temperatures near the melting point the molecules possess free rotation. At lower temperatures a definite movement must also be supposed. The crystals of cyclohexanol ($C_6H_{11}OH$), cyclohexanon ($C_6H_{10}O$) and chlorcyclohexane ($C_6H_{11}Cl$) are cubic immediately below the melting point, and the molecules also rotate in these lattices. C. J. B. C.

**4304. Diffraction of X-Rays in Organic Glasses. T. M. K. Nedungadi.** *Indian Acad. Sci., Proc.* 8*A*. *pp.* 65–72, *Aug.*, 1938.—Using a modified form of the ordinary X-ray diffraction arrangements, three organic substances, namely glycerin, salol and benzophenone have been investigated both in the liquid and glassy conditions by means of X-rays. The changes observed in the diffraction patterns when the liquid changes into glass are (1) a large decrease in the scattering at small angles with the primary beam, (2) a considerable sharpening of the haloes, and (3) a widening of the haloes. The first two effects have been explained by taking into consideration the large decrease in the compressibility of the substance as it changes from the liquid to the glassy state and the last one as due to the decrease of the intermolecular distance to form a closer packing of the molecules in the solid condition. AUTHOR.

**4305. Double Refraction of Anisotropic Liquids. W. Kast.** *Ann. d. Physik*, 33. 3. *pp.* 185–191, *Oct.*, 1938.—A large number of measurements of double refraction are given, and a discussion included of the molecular arrangements in the turbid melt compared to the order within the molecular swarm where the distribution is completely irregular. A certain reciprocal effect within the swarm, however, is indicated by the fact that the dispersion of light remains practically constant with increasing temperature, while the square of the double refraction decreases. An effect must also exist which compensates the decrease of light dispersion by the decline of double refraction, which can be explained by increase of orientation differences of neighbouring swarms with increasing temperature. The energy exchanges between the swarms is of the same dimensional order as the energy of the thermal movements. H. H. Ho.

**4306. Calorimetric Measurements during Transition from the Anisotropic to the Isotropic Phase. C. Kreutzer.** *Ann. d. Physik*, 33. 3. *pp.* 192–209, *Oct.*, 1938.—A differential method with full experimental details, and scheme of apparatus is first described for the direct measurement of the difference of specific heats and the heats of transformation from the anisotropic to the isotropic phases of para-azoxyanisole, para-azoxyanisole phenetole and para-azoxyphenetole. The specific heat in the isotropic phase is found to be smaller than in the anisotropic phase for

all the above substances, a fact explained by the dense parallel packing of the long molecules in the latter phase, and the inner molecular changes. The heats of transformation were both qualitatively and quantitatively established, and found to increase with the size of the end-group, from which it is concluded that the minimum of potential energy for parallel arrangement of the molecules is lower according as the end-groups are greater. H. H. Ho.

**4307. Field Strength Dependence of the Dielectric Constant of *p*-Azoxyanisole. W. Maier.** *Ann. d. Physik*, 33. 3. *pp.* 210–225, *Oct.*, 1938.—A method for the measurement of the dielectric constant is described, which permits, at constant frequency, changes alone in the amplitude of the alternating field, so that the influence of the latter can be established. It is thus shown that the dielectric constant of *p*-azoxyanisole increases with increasing field strength. All the disturbing influences which have invalidated earlier measurements were carefully avoided. This effect is analogous to the well known influence of a longitudinal magnetic field, which produces a diminution of the dielectric constant. Since a magnetic field orientates the swarm axis parallel to the lines of force, the conclusion was drawn that the swarms transverse to this axis were more strongly polarisable than those parallel thereto. In the electric field, therefore, it was to be expected that there would be a transverse orientation of the swarms and an increase of the dielectric constant. This is discussed along with an alternative condition of rotation-hindering of the dipole molecules. H. H. Ho.

**4308. Production of Long Single Crystals of Aluminium Drawn Wire. T. Fujiwara and T. Hudita.** *Hirosima Journ. Sci.* 8. *pp.* 293–296, *Aug.*, 1938. *In English.*—Two methods of producing a long single crystal of metallic drawn wire by submitting it to mere annealing, without any stretching, etc., are described. AUTHORS.

**4309. Low-Temperature Transformation of $ND_4Br$. Part I. A. Smits, D. Tollenaar and F. A. Kröger.** *Zeits. f. phys. Chem.* 41. *Abt.B.* 3. *pp.* 215–235, 1938.—Pure $ND_4Br$ was prepared and its transformations at low-temperatures studied dilatometrically. The transformation to the tetragonal from the cubic modification occurs at $-58°$ C. and exhibits hysteresis to an extent of about $0{\cdot}15°$ C.; the corresponding transformation for $NH_4Br$ is at $-39°$ C. The change in molecular volume is $0{\cdot}06$ cc. The further transformation found by Clusius, by using the polarisation microscope, was also found by the dilatometric method, but the hysteresis is about 9° C. The change in molecular volume is about $1{\cdot}08$ cm$^3$. and the crystals become cubic again. X-ray photographs of these two cubic modifications show they both have the CsCl structure and are completely identical A discussion on phase rule lines follows and it is pointed out that this is the first definite example of a " reverse transformation." These results, in contrast to those obtained with $NH_4Br$, are discussed in the light of the replacement of H by D. G. G.

**4310. Nature of Excited Centres in Alkali-Halide Crystals. H. Wolff.** *Zeits. f. Physik*, 110. 7–8. *pp.* 512–528, 1938.—Excited centres are produced in crystals of different degrees of purity. It is found that the number of excitable centres and the displacement of their absorption band as compared with the unexcited band increase with the impurity content. A similar displacement of the band can also be brought about by plastic deformation, and the maximum displacement which can be

produced by impurities would correspond to a stress equal to the " ideal " strength of the crystal lattice. If the excited impure crystals are plastically deformed, there is no further red-shift of the absorption band. It is therefore concluded that the excited centres are always connected with places of high internal strain, produced either by impurities or by plastic deformation. R. P.

**4311. Magnetic Anisotropy and Structure of $CuSO_4 \cdot 5H_2O$. Part II. K. S. Krishnan and A. Mookherji.** *Phys. Rev.* 54. *pp.* 533–539, *Oct.* 1, 1938.—In Part I of this paper [see Abstract 5383 (1936)] were reported some magnetic measurements on the crystal of $CuSO_4 \cdot 5H_2O$. The crystal, though triclinic, has nearly uniaxial magnetic symmetry, and the symmetry axis is the direction of minimum susceptibility for the crystal. This observed uniaxial symmetry and the negative sign of the anisotropy were shown to follow naturally from the known fine structure of the crystal, and the direction of the symmetry axis also is nearly that predicted from the structure. In the present paper are described further magnetic studies on the crystal, and a more detailed correlation with its structure. The magnetic data are also discussed in relation to the magnitude and the asymmetry of the internal electric fields acting on the $Cu^{++}$ ions in the crystal. A general method is described for determining, for any triclinic crystal, the principal magnetic axes and susceptibilities, *i.e.*, the constants of the magnetic ellipsoid. AUTHORS.

**4312. Integration of Large Numbers of X-Ray Crystal Reflections. R. H. V. M. Dawton.** *Phys. Soc., Proc.* 50. *pp.* 919–925, Nov. 1, 1938.—The experiments described show that if a positive film is printed from an X-ray negative, the change in the transparency of the former can be made directly proportional, over an extended range, to the intensity of the original X-ray beam. The transmitted light can, therefore, give the integrated X-ray value of a patch of non-uniform blackening without the necessity of a two-dimensional point-by-point integration. The application of this principle to X-ray analysis of crystal structure is discussed. AUTHOR.

*See also* Abstracts 4289, 4291, 4330, 4352, 4562, 4570, 4571, 4639.

## DENSITY.

*See* Abstracts 4281, 4282, 4366, 4580, 4644, 4648.

## DIFFUSION AND OSMOSIS.

**4313. Diffusion of Water Enriched with $H^2$ and $O^{17}$ through Dilute Gelatin Gel. N. Morita and T. Titani.** *Chem. Soc., Japan, Bull.* 13. *pp.* 543–555, *Aug.*, 1938. *In German.*—The diffusion of water rich in $H_2^2O^{17}$ in dilute gelatin gels (about 5%) has been determined by two methods, which give $1 \cdot 12$ cm$^2$. per day and $1 \cdot 83$ cm$^2$. per day at 6°, respectively, for the diffusion constants. The true value lies between these limits. In both methods it was found that the $O^{17}$ atoms diffused as rapidly as the $H^2$ atoms, and it is concluded that the additional diffusion of hydrogen atoms through their exchange with neighbouring $H_2O$ molecules can be neglected in comparison with the ordinary diffusion of $H_2O$. A. J. M.

**4314. Diffusion of Non-Electrolytes in Organic Liquids. O. Lamm.** *Faraday Soc., Trans.* 34. *pp.* 1152–1158, *Sept.*, 1938.—This paper is a general discussion on formulæ relating the diffusion constant to the radius of the diffusing molecule and the viscosity of the solvent, etc.

A new approach to the question is given by starting from Andrade's formula for the viscosity of a monatomic liquid near the freezing point, and includes the use of Rayleigh's theorem. The general problem of viscosity and diffusion of binary mixtures is considered and both formulæ and results are given. The paper contains a large number of references.
E. H. D.

**4315. Diffusion of Water in Glycerin. O. Lamm and G. Sjöstedt.** *Faraday Soc., Trans.* 34. *pp.* 1158–1163, *Sept.*, 1938.—The method used was that known as the refractometric "scale" method which has previously been described in detail [see Abstract 824 (1930)]. Full details of the present experiments are given for diffusion, viscosity and density. Diffusion was found to be abnormally rapid, and this is explained as being due to non-existence of a bond between the water and the glycerin molecule, or to the fact that the diffusibility of the water is not determined simply by the viscosity of glycerin. E. H. D.

## ELASTICITY AND PLASTICITY.

**4316. Solution of the Fundamental Problems of Plane Theory of Elasticity in the Case of Contours with Corners. L. Magnaradze.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 673–676, 1938. *In English.*

**4317. Theory of Plastic Stability and its Application to Thin Plates of Structural Steel. P. P. Bijlaard.** *K. Akad. Amsterdam, Proc.* 41. 7. *pp.* 731–743, 1938.—[See also Abstract 3604 (1938)].

**4318. Plastic Deformation of Pb, Cu and Al Under Static Compression. W. J. Lyons.** *J. of Applied Physics*, 9. *pp.* 641–646, *Oct.*, 1938.—Creep in metals under constant load indicates that plastic deformation depends on the duration as well as the magnitude of the compressive force. The dependence of deformation on duration is significant in the lead crushers used in measuring pressures. Static compression tests on lead, extending over 30-min. periods, and under various loads up to 109 kg. have been conducted. The dependence of deformation on duration is found to be great under the higher loads, and much greater than the dependence in the case of Cu and Al, on which comparative tests were made. The deformation-compression-time relation is found to be approximately linear under constant pressure. The present data are in agreement with the results of Bogomolov and Kunin on lead for pressures in a higher range. However, the law derived by them does not hold in the pressure-range of the present tests. Author.

**4319. Eigenwert Problems for the Rectangular Elastic Plate. S. Iguchi.** *Hokkaido Imp. Univ., Eng. Mem.* 4. *pp.* 305–372, *Aug.*, 1938. *In German.*—Formulæ are obtained for the frequencies of the normal modes of transverse vibration of a rectangular elastic plate of uniform thickness, for each of the six possible combinations of edge conditions in which any edge is either simply supported or clamped. Graphs showing the variations with the ratio of the sides are given. The effect of direct and shear stresses applied to the edge, in the plane of the plate, is also considered, and critical values of these stresses are determined.
W. G. B.

**4320. Fracture of Glass Plates by Percussion. T. Okaya and K. Ishiguro.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 540–546, *July*, 1938. *In French.*—In continuation of previous work [see Abstract 3885

(1937)], experimental results are discussed mathematically and expressions deduced connecting the coefficient of fracture with the angle of percussion. F. S.

**4321. Self-Hardening as a Method for Increasing Strength of Glass. I. I. Kitaigorodsky.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 711–714, 1938. *In English.*—Compound sheets of glass have been formed, the outer layers being of quick hardening glass and the inner layers of slow hardening glass. Of two pairs of glasses, the results are found equal in mechanical strength to a commercial glass known as "securite." Coloured glass may also be made by combining layers of coloured and colourless glasses. F. S.

*See also* Abstracts 4339, 4576, 4602, 4723.

## GRAVITATION.

***4322. Static Gravimeter for Measurements on Land and Sea. H. Haalck.** *Beitr. z. angew. Geophys.* 7. 3. *pp.* 285–316, 1938.—A detailed description is given of the latest type of gravimeter [see Abstract 4098 (1935)] with the theory of the instrument, method of use, source of errors and precautions to be observed for their avoidance. The accuracy attainable is on land $\pm$ 1 m.gal. and on sea (if reasonably smooth) $\pm$ 1–5 m.gal. C. A. S.

## HYDRODYNAMICS AND AERODYNAMICS.

**4323. Turbulence of an Air Current. K. Kitagawa.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 586–589, *July*, 1938.—The magnitude of the dispersion produced by the turbulent convection of an air current is proportional to the space covered. It is shown that this statistical relation corresponds with that found for the draining of subterranean water [see Abstract 2281 (1936)]. N. M. B.

**4324. Drag Coefficient of Plate in Steady Stream. T. Okaya.** *Phys. Math. Soc. Japan., Proc.* 20. *pp.* 625–635, *Aug.*, 1938. *In French.*—An approximate value of the drag coefficient of a thin plate placed in a steady stream of viscous fluid is obtained in terms of characteristic incomplete gamma functions and of characteristic functions of the probability integral. J. S. G. T.

**4325. Flow of a Compressible Fluid Past a Circular Cylinder. I. Imai.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 636–645, *Aug.*, 1938. *In English.*—An analysis of the flow of a uniform stream of compressible fluid past a circular cylinder is carried out to a second order of approximation by a method similar to that used by Janzen and by Rayleigh, who found solutions to a first order of approximation only. The second-order correction, arising from compressibility of the fluid, contains terms involving $\gamma$ (the ratio of spec. heats) and terms independent of $\gamma$. The results are in good agreement with Taylor's observations [see Abstract 382 (1929)]. J. S. G. T.

**4326. Forces on Two Spheres Placed in Uniform Flow. D. Endô.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 667–703, *Aug.*, 1938. *In English.*—The velocity potential for the flow past two fixed solid spheres is found in terms of the bipolar coordinates in three dimensions. Coefficients in it must be determined successively because it seems difficult to obtain their general expressions. In the special case when the flow is parallel to the central line, the stream function can be used and the

coefficients in it can wholly be determined. Then the resultant fluid pressures on the spheres are calculated and discussed numerically. Most of the results are quite similar to the case of two circular cylinders except the magnitude of the limiting critical angle. Finally the integral formulæ used in the text are given in an Appendix, as well as the tables of Legendre functions and their derivatives for arguments greater than unity. AUTHOR.

**4327. Transition from Laminar to Turbulent Flow in the Boundary Layer of a Sphere. S. Tomotika and I. Imai.** *Tokyo Univ. Aeronaut. Research Inst., Report No.* 167. *pp.* 389–423, *Aug.*, 1938. *In English.*—The momentum integral equation for the boundary layer on a surface of revolution is applied to the case of the boundary layer of a sphere placed in a uniform stream; the flow in the boundary layer is assumed to be laminar and the velocity distribution in the layer is given by a quartic expression. The differential equation determining the thickness of the laminar boundary layer is solved graphically in each of 3 cases, *viz.*, for values of the Reynolds number (1) just within, (2) near the middle of, and (3) above, the critical range. In case (1) satisfactory agreement is found between theory and Fage's experimental results. In case (2) it appears that transition from laminar to turbulent flow in the boundary layer begins at a point near that of minimum pressure. In case (3) the transition begins at a point in front of the point of minimum pressure. The critical value of the Reynolds number is about 1450.

J. S. G. T.

**4328. Theory of Turbulence. C. Ferrari.** *Accad. Sci. Torino, Atti*, 73. *Disp.* 3*a*. *pp.* 373–396, *April–June*, 1938.—The statistical theory of turbulence, due to v. Kármán, is extended and applied to a number of problems, including damping and the correlation of velocity components.

W. A. R.

**4329. Use of a Vertical Pipe as an Overflow for a Large Tank. A. M. Binnie.** *Roy. Soc., Proc.* 168*A*. *pp.* 219–237, *Oct.* 25, 1938.—The performance of vertical pipes arranged as overflows in a tank was studied experimentally on a small scale with special apparatus, which ensured that the water reached the pipe inlet with no tangential component of velocity. Under normal conditions, the change of head with discharge was small at low heads. At this stage the flow was not rotational, but a considerable volume of air was drawn down the pipe in the form of bubbles. Above a sharply marked critical head, the pipe ran full and a large rise of head caused only a slight increase in the discharge. The effects on the critical head of lengthening the pipe and of sharpening its inlet end were comparatively small, but the insertion of a trumpet-shaped mouthpiece greatly improved the performance. The types of flow described by Borda as free and full flow were possible with overflow pipes of uniform diameter, and they resulted in a serious reduction in the discharge.

AUTHOR.

*See also* Abstracts 4578, 4591.

## KINETIC THEORY OF MATTER.

**4330. Free Volumes and Free Angle Ratios of Molecules in Liquids. J. F. Kincaid and H. Eyring.** *J. Chem. Phys.* 6. *pp.* 620–629, *Oct.*, 1938.—The free volume is defined as the total integral over that part of the potential energy of the molecule in the liquid which is due to thermal displacements of the centre of gravity of the molecule from its equilibrium position. The free angle is the corresponding integral over angular dis-

placements of the molecule. The free volume, $V_f$ is related to the velocity of sound, $u$, in the liquid by $u$ (liquid) $= u$ (gas) $(V/V_f)^{\frac{1}{3}}$. This equation is used to derive a formula connecting the sound velocity in the liquid with its thermal conductivity. The quantity, $RT/p \exp(\Delta H/RT)$, gives the *product* of the free angle ratio and the free volume, rather than the free volume itself. Here $p$ is the vapour pressure and $\Delta H$ is the heat of vaporisation. The free volumes from sound velocities agree with those determined by independent methods. Specific heats, entropies of vaporisation, the spectroscopic observations of Cartwright, and the differences between sound velocity, free volumes and the function $RT/p \times \exp(\Delta H/RT)$ are examined from the point of view of restricted rotation of the molecules in liquids. Lack of free rotation of molecules suffices to explain the abnormalities of the liquids examined. The dielectric constants of polar liquids are interpreted assuming restricted rotation and the following formula is derived: $\mu_l^2\mu_g^{-2} = 1 - ((1 + \cos\theta_1)/2)^2$, where $\mu_l$ is the apparent dipole moment of the molecule in the liquid, $\mu_g$ is the dipole moment as determined from measurements in the gas phase, and $\theta_1$, is the polar angle related to the free angle ratio, $\delta_2$, by $\delta_2 = (1 - \cos\theta_1)/2$. The concept of restricted rotation of the molecules in the liquid accounts satisfactorily for the observed dielectric polarisations of water and methyl alcohol. AUTHORS.

**4331. Determination of the Cross-Section of Metastable He Atoms with the Aid of Their "Photoelectric" Effect. R. Dorrestein and J. A. Smit.** *K. Akad. Amsterdam, Proc.* 41. 7. *pp.* 725–730, 1938.—A method is described by which the cross-section of metastable He atoms for collisions with normal He atoms is determined by measuring the intensity decrease of a beam of metastable atoms in He of low pressure. The relative number of metastable atoms is measured with the help of the electrons they liberate from a metal surface. AUTHORS.

## LENGTH, AREA AND VOLUME.

***4332. Precision Measurements with the Micrometer Eyepiece. H. Rühle.** *Zeits. f. Instrumentenk.* 58. *pp.* 355–374, *Sept.*, 1938.—The author is concerned with the errors which arise in setting the cross-wire of a micrometer onto the edge of a luminous object, due to contrast effects in the eye. In the experiments the luminous "object" consisted of the image of an illuminated aperture, formed by a telescope objective. The actual size of the image was determined by calculation and compared with the apparent size given by the micrometer settings. The variations of the error with object brightness and exit pupil size were determined. The results are interpreted, taking into account the contrast sensitivity of the eye and the "grain" of the retina. W. S. S.

***4333. Divided Circles. W. Krug and H. Oehler.** *V.D.I.* 82. *pp.* 797–804, *July* 2, 1938.—A review of the problem and present solution of the manufacture of divided circles, such as are required in many types of instrument, such as theodolites. The line of present research is indicated together with an illustrated description of calibrating and measuring plant, including an automatic divider. The question of making masters for multiple work is also discussed. L. E. C. H.

***4334. Optical Spherometer for Non-Reflecting Surfaces. C. S. Venkateswaren.** *Zeits. f. Instrumentenk.* 58. *pp.* 321–323, *Aug.*, 1938.—The device consists in placing two exactly similar optically flat mirrors in

contact along one edge, each mirror being in contact also with the spherical surface. The angle between the two mirrors is then measured with an autocollimating telescope fitted with a micrometer. W. S. S.

*See also* Abstract 4644.

## MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

**4335. Operational Forms and Contour Integrals for Struve and other Functions. N. W. McLachlan.** *Phil. Mag.* 26. *pp.* 457–473, *Oct.*, 1938.

***4336. Measurement of Angles. C. Schmerber, P. Tardi and P. Caillol.** *Bull. géodésique, No.* 56. *pp.* 290–295, *Oct.–Nov.–Dec.*, 1937.—It is pointed out that with modern instruments employing filar micrometer eyepieces, there is no reason why the angles in a fundamental triangulation should not be measured by the repetition method, rather than by the reiteration method now in use. A method of " fractional repetition " which avoids intermediate microscope readings is described for use with a reiterative instrument, and its advantages over the present method are outlined. The construction of an azimuth circle for testing the method is described, with a numerical example as illustration. A. Hu.

**4337. Use of Probability Paper. E. W. H. Selwyn.** *Phys. Soc., Proc.* 50. *pp.* 914–918, *Nov.* 1, 1938.—The method of plotting observations on probability paper becomes clear when the curve on probability paper is regarded as an integral of the histogram. The observations are divided into intervals, which may often conveniently be the natural interval of measurement, and the total frequency of observations up to and including the $n$th interval is plotted against the upper end of the $n$th interval. It is shown that in drawing a straight line to fit the observations, less weight should be attributed to deviations from the line towards its ends than in the middle regions. AUTHOR.

**4338. Coordination of Units of Measurement. M. Simonoff.** *Univ. Nac. La Plata, Publ. No.* 116. *pp.* 5–24, 1938.—From a critical discussion of $\mu$ and $\epsilon$ in e.s.u. and e.m.u., the author concludes that the divergence proves that magnetic mass should be interpreted as the quantity of movement of electric mass. He would establish a system based on the provisional interpretation of magnetic mass, and replacement of material mass M by electrical mass $M_e$ ($M^{\frac{1}{2}} L^{\frac{1}{2}}$). From the failure of attempts to homogenise units of the same type in different systems based on the Newtonian law, he would define mass in terms of acceleration, eliminating it between the fundamental units. He considers the two-dimensional (L,T) Newtonian system as absolutely and universally true, and classifies collections of bodies or masses according to Newton's law, using local units. The new units may also be applied to the planetary system, " terrestrial " units being based on the acceleration due to gravity and the mean density of the earth, planetary local units being derived similarly. Planetary mass is tabulated in relation to other characteristics. Local systems based on solar attraction and the moments of planetary mass allow the " planetary day " to be defined and the sidereal period to be determined in terms of local days. The planetary years for Mercury, Mars, Jupiter, Saturn, Uranus and Neptune, expressed in this way, all lie between 361·72 and 362·72, that of the earth is 365·26, and of Venus 395·76. Fusion of the electrostatic and electromagnetic systems without recourse to hypothetical

dimensions for $\mu$ and $\epsilon$, as also the definition of the true character of metric systems based on Newtonian mechanics, is yet wanting. D. R. H.

*See also* Abstracts 4577, 4579, and
3184B. Notion of an Angle. E. Brylinski.

## MECHANICS, CLASSICAL.

**4339. Mechanics of Elastic Collisions. Parts II and III. C. Cattaneo.** *Accad Lincei, Atti*, 27. *pp.* 434–436, *May* 1, *and pp.* 474–478, *May* 15, 1938.—Continuing previous work [see Abstract 3523 (1938)] in which the tangential components of the local forces in the region of contact of two elastic bodies colliding obliquely was dealt with, a determination is now made of the normal component over the whole area $\sigma$ of the contact. The author then discusses the procedure for applying his equations, which are only strictly valid for a smaller area $\sigma^*$, to the whole area $\sigma$ of the contact for the determination of the tangential action. In Part III the actual determination is given. G. G.

**4340. Graphical Arrangement of Accelerations of Points of Plane Figure in its own Plane. M. Manarini.** *Ricerche di Ingegneria*, 6. *pp.* 66–74, *May–June*, *pp.* 119–125, *July–Aug.*, 1938.—A wide study is developed on the graphical arrangement of the accelerations in the plane of motion of a rigid system by deducing, by the unitary method, laws that complete those already known. For every straight line of the moving plane there is established the existence of a succession of straight lines, and of circumferences related to the same, with which is strictly connected the graphical determination of the accelerations of the respective points. Particular cases are considered. J. J. S.

***4341. Variable-Length Pendulum. M. Zeuli.** *Accad. Lincei, Atti*, 27. *pp.* 444–450, *May* 1, 1938.—Another method to investigate Lecornu's approximate solution and its limits of error. W. A. R.

**4342. Distribution of Mass, Velocity, Momentum and Energy of Broken Pieces of Exploded Bodies. Part III. S. Suzuki and H. Nagasima.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 517–539, *July*, 1938. *In English.*—The study is made of the distribution of the broken pieces of balls of chalk and plaster of Paris, when they are exploded at their centre. The frequency-distribution of the velocity of the broken pieces of both materials follows rather closely Maxwell's law, while those of the mass, momentum, and energy behave quite differently and increase with their decrease according to the following equation, $y = (A - B \log x)^2$. The broken pieces are divided into two groups. One contains the larger pieces and probably follows Maxwell's law of distribution, whereas the other contains smaller pieces and follows a so-called pseudo-hyperbolic distribution. The correlation is most intimate between mass and momentum, less between mass and energy, and least between mass and velocity. All of the broken pieces revolve around their own axis, with a very few exceptions, and the angular velocity, which frequently appeared, is of the order 50 r.p.s. [For Parts I and II see Abstracts 1263 and 4544 (1936).] See also *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 828. *pp.* 1086–1122, *Oct.*, 1938. *In English.* AUTHORS.

**4343. Geometrics in Euclidean Space. R. de Saussure.** *Arch. des Sciences*, 20. *pp.* 117–122, *May–June*, 1938.—A summary of the views on geometry and the conclusions arrived at by the author in a series of papers published over the years 1898 to 1921. N. M. B.

*See also* Abstract 4644.

## MECHANICS, QUANTUM.

**4344. Elementary Demonstration of the Wentzel-Brillouin Method. E. Persico.** *N. Cimento*, 15. *pp.* 133–138, *March*, 1938.—It is shown that the method of Wentzel and Brillouin which combines the Sommerfeld quantising condition with wave mechanics, may be put into a simple didactic form, that makes direct appeal to intuition and avoids the use of higher mathematics. C. J. B. C.

**4345. Limits of Applicability of the Present Quantum Theory. W. Heisenberg.** *Zeits. f. Physik*, 110. 3–4. *pp.* 251–266, 1938.—The quantum theory of wave fields, developed in a manner in which the relativistic invariant characteristics of the theory are clearly recognisable, necessitates the postulation of two natural hypotheses relating to limits within which application of the present quantum theory is justified. The one assumption is contained in the statement that a process can be treated in accordance with the formulæ of quantum mechanics only when for each particle at every point of time of the process, a time interval, $\Delta t \gg r_0/c$, can be specified such that during this interval the particle experiences no change ($r_0$ in the expression being of the order of magnitude of the classical electronic radius, *viz.*, $2{\cdot}81 \times 10^{-13}$ cm.). The hypotheses are applied to the discussion of special cases, *e.g.*, the motion of protons and neutrons in the nucleus, the diffraction of waves by a lattice in which the hypotheses are satisfied, and to the case of $\beta$-disintegration, in which the hypotheses are not satisfied. J. S. G. T.

*See also* Abstracts 4348, 4349, 4453, 4545, 4721.

## PRESSURE.

***4346. Simple Safety Sealing Device for High-Vacuum Pumps. K. Seiler.** *Zeits. f. techn. Physik*, 19. 9. *pp.* 283–284, 1938.—A mercury switch is used in the present device as follows: The overflowing cold water flows into a glass vessel which is fixed below an outlet. The vessel hangs at one end of a balance beam, on the other side of which the three-pole mercury switch tube is fixed, together with a definite counterpoise weight. Behind the switch a switch-board is fixed, to which the three leads from the mercury switch are taken and fixed. Two knife-edge fulcrums are fixed on the board also to carry the balance beam. The counterpoise weight is so adjusted that when the glass vessel on the outflow circuit is filled to a certain point, the balance beam rotates and short-circuits the correct poles of the mercury switch. The device is such that a warning lamp can be brought into circuit if the vacuum pump is not working effectively and also shuts out the current effectively thus sealing the vacuum. This happens as soon as the overflow tube is filled to the desired height. S. G. B.

*See also* Abstracts 4318, 4644, 4664.

## RELATIVITY AND ETHER.

**4347. Criticism of the Special Theory of Relativity. A. Eagle.** *Phil. Mag.* 26. *pp.* 410–414, *Sept.*, 1938.—The author arbitrarily regards the synchronisation of clocks by means of light-signals as "erroneous." He points out that if clocks are synchronised instead by means of rigid driving-rods connecting the clocks, the "time" kept by such clocks will

not be the " time " envisaged in the Lorentz transformations of special relativity. G. C. McV.

**4348. Eddington's World-Theory. E. Schroedinger.** *N. Cimento*, 15. *pp.* 246–254, *April*, 1938. *In French.*—A short summary of Eddington's recent work on the unification of relativity and quantum theory is given. The importance of the finiteness of space and of Eddington's " threshold " level of energy for the state of a primitive material particle are emphasised. The difficulty that Eddington's theory implies complete degeneracy of the material content of the universe together with very low average density is not, it is suggested, insurmountable. G. C. McV.

**4349. Generalisation of Relativity Transformations. G. Wataghin.** *Comptes Rendus*, 207. *pp.* 421–423, *Aug.* 22, 1938.—An examination has been made previously [see Abstract 4170 (1938)] of the formalism of the quantum theory, which is based on the hypothesis of the existence of new limitations to our possibility of defining and measuring physical magnitudes, and of a new indetermination in the domain of impulses possessing very large relative energies. In the present paper the author attempts to show that the existence of these limitations necessitates the generalisation of the group of transformations which constitute the basis of relativity. It is found that the unitary transformations which substitute and generalise the relativity transformations (by promoting the passage from one measuring arrangement to another) also transform the subdivision of the phase space into a finite number of quantum cells relative to a corresponding reference system. H. H. Ho.

**4350. New Systems of Normal Coordinates for Relativistic Optics. G. Temple.** *Roy. Soc., Proc.* 168A. *pp.* 122–148, *Oct.* 10, 1938.—This paper develops the theory of a new system of normal coordinates $(y^\mu)$ in an $n$-dimensional manifold with an indefinite metric of signature $+1-(n-1)$. In this system of coordinates the expression for the metric has the form $ds^2 = h_{jk}dy^j dy^k + 2dy^{n-1}dy^n$, $(j, k = 1, 2, \ldots, n-1)$. Any arbitrary time-like curve C being taken as the base curve, the forward null cone at any point A on C is given by $y^{n-1} =$ constant, C itself is given by the single equation $y^n = 0$, and any forward null geodesic G from A is given by $y^j =$ constant $(j = 1, 2, \ldots, n-1)$. $y^n$ is the " projected length " defined in a general coordinate system $(x^\mu)$ by $y^n = \int K_\mu dx^\mu$, where the integral is taken along G from A, and $K_\mu$ is a unit vector transported along G by parallel displacement and forming the tangent to C at A. Hadamard's theory of null geodesics as bicharacteristics leads to a generalisation of this system of normal coordinates in which $y^{n-1} =$ constant is the equation of a system of wave fronts, $y^j =$ constant are the equations of the orthogonal null geodesics or rays, and $y^n$ is a projected length measured along the rays. The theory is applied to optical problems in general relativity. Fermat's principle of minimum time is established rigorously for any relativistic manifold. The discussion of astronomical determinations of distance is simplified by the use of the new system of normal coordinates, which gives explicit expressions for the various distance functions. These general results are illustrated by the case of a manifold representing an isotropic expanding universe. Incidentally the use of normal coordinates of Riemann's type in relativistic optics is justified by a new definition in terms of " projected distances". AUTHOR.

*See also* Abstracts 4380, 4381, 4470.

## SOLUTION.

**4351. Interaction between Solutes and Polar Solvents. W. J. Dunning and W. J. Shutt.** *Faraday Soc., Trans.* 34. *pp.* 1192–1202, *Oct.*, 1938.—The solubilities at 25° C. of $PbCl_2$ in water and in aqueous solutions of glycine and urea have been determined. It is shown that the results qualitatively obey the Born equation relating solubility with dielectric constant of the solvent. The ionic radius, calculated with the aid of this equation, is probably in error owing to the impossibility of correcting adequately for the ionic interaction energy in solutions so concentrated as saturated $PbCl_2$. The solubilities of AgCl have been determined in the same media using a special method depending upon electrometric titration. The solvent-solute interaction energy has been calculated and a value for the mean ionic radius computed. The solubility of glycine in aqueous solutions of urea has been determined. The saturation concentration of glycine (moles per litre) decreases with increasing concentration of urea, but the solubility of glycine referred to water alone (gm. glycine per 1000 gm. water) remains practically constant for urea concentrations between zero and five molar. This difference between the solubility relations of zwitterions and those of simple ions is interpreted in terms of the shorter range of the electrostatic forces around the zwitterions. AUTHORS.

**4352. Non-Aqueous Solutions. V. A. Plotnikov.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 707–710, 1938. *In English.*—A catalogue of some of the properties of non-aqueous solutions. The formation of large molecular aggregates (quasi- or forecrystals) in *e.g.* a solution of KBr and $AlBr_3$ in $C_6H_6$ is discussed, and the term "ionising tendency" or "dissociating power" criticised. Crystallisation of $AlBr_3$ from a $C_2H_5Br$ solution, and of acetamide from a bromine solution, both solutions having considerable electrical conductance, is taken to indicate that other compounds are precipitated on crystallisation than those which are present in solution. F. J. L.

*See also* Abstracts 4278, 4638.

## SURFACE PROPERTIES.

**4353. Duration of Energy Interchange between Gas-Molecules and a Solid Surface. W. Hunsmann.** *Zeits. f. Elektrochem.* 44. *pp.* 606–610: *Disc.*, 610, *Sept.*, 1938.—It is shown that the thermal accommodation coefficient $\alpha$ can be represented by $\alpha = \tau/(\tau + \beta)$, where $\tau$ is the mean absorption-time, or time of stay of a gas molecule on a surface, and $\beta$ the time in which its temperature alters by $1/e$ of the difference between its initial temperature and that of the surface. Since $\alpha$ and $\tau$ can be experimentally determined it becomes possible to derive values for $\beta$. This is done for reactions between the gases $SF_6$, $N_2O$ and $C_2H_6$ and surfaces of quartz and of oxidised Ni over the range $-100°$ to 100° C. For the latter surface values of from $10^{-8}$ to $10^{-9}$ sec. are obtained for $\beta$, but for quartz the values are 20 to 50 times smaller. This result agrees with the predictions of Herzfeld and Mayer [see Abstract 3981 (1931)]. R. W. P.

**4354. Thermal Properties and Heats of Adsorption of Films on Vitreous Silica. W. G. Palmer.** *Roy. Soc., Proc.* 168 *A. pp.* 190–206, *Oct.* 25, 1938.—Isothermals have been obtained at temperatures between 70 and 25° for adsorption of the vapours of benzene, acetone and methyl alcohol on known surfaces of vitreous silica, by methods giving a check on the constancy of the surface condition. The values of the coefficients of

thermal expansion, compressibility and the temperature variation of the lateral force have been calculated and discussed in relation to parallel properties of the bulk phase. The heats of adsorption have been calculated from the temperature variation of the adsorption potential. Their relations to the fraction of surface covered are in agreement with theoretical predictions for films with interaction energy. AUTHOR.

**4355. Surface Activity of Aqueous Solutions of Organic Ions with Hydrophobic Groups. Y. Mutō.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 646–652, *Aug.*, 1938. *In English.*—Organic ions with hydrophobic groups have a tendency to be adsorbed at a surface on account of those groups : their electric charge tends to force them out of the surface. It is conceivable then that the surface activity of aqueous solutions with hydrophobic groups will be increased by the addition of inorganic salts or, in general, strong electrolytes. The equation of adsorption of such ions is determined theoretically when the adsorbed amount is (1) small, (2) large. J. S. G. T.

**4356. Adsorption of Metal Ions at Metal Surfaces. O. Erbacher.** *Zeits. f. Elektrochem.* 44. *pp.* 594–598 : *Disc.*, 598, *Sept.*, 1938.—By simple exchange of metal atoms and baser ions at a metallic surface it is possible to determine the absolute surface of metals after different pre-treatment. Knowing this, the equivalent adsorption of ions in the system metal-baser ions can be determined. In the case of Pb ions adsorbed on Ag, Ni, or Au, the general adsorption isotherm holds. Qver a range of 60° the mass of ions adsorbed was found to be independent of temperature, and approximately the same as in all metal-base kation systems investigated up to the present. This is only true, however, if the concentration of the base kations in the solution is sufficiently great to cause more than half the metal surface to be covered. In addition to primary adsorption where the adsorption of kations is accompanied by an equivalent exchange of anions, a secondary adsorption was observed. A. J. M.

**4357. Adsorption of Colloidal Graphite from Oleosols at Metallic Surfaces. F. Pavelka and A. Wischin.** *Kolloid Zeits.* 84. *pp.* 334–339, *Sept.*, 1938.—It is concluded that an iron surface had adsorbed graphite after treatment with a graphite oleosol from that change of its surface tension with respect to a mineral oil. This alteration in surface tension was only clearly established when the action of the oleosol had been prolonged or when the viscosity of the oleosol had been strongly reduced by dilution. A suitable diluting agent was petroleum and at 1 : 1 the surface tension of the iron was found to have altered after 15 hours' treatment. Full experimental details and a discussion of their theoretical basis are included. H. H. Ho.

**4358. Activation of Charcoal. F. E. Bartell and L. E. Lloyd.** *Am. Chem. Soc., J.* 60. *pp.* 2120–2125, *Sept.*, 1938.—Preferential adsorption from benzene-ethanol solutions by charcoals activated at different temperatures and in different gases shows that charcoal can be changed from extremely organophilic charcoal to charcoal approaching in adsorptive properties the hydrophilic adsorbent, silica. The characteristic S-shaped preferential adsorption curves for a series of increasingly hydrophilic charcoals have been plotted, and the points where these curves cross the X-axis, the $X_0$ values, are shown to be a measure of the relative organophilic or hydrophilic nature of the charcoals. The organophilic "high temperature charcoal" (activated at temperatures near 1000°), when suspended in water, gave both positively and negatively charged

particles. This charcoal gave acid, but no base, adsorption. The less organophilic "medium temperature charcoal" (activated at temperatures near 400°), when suspended in water, gave only negatively charged particles and base adsorption. The "low temperature charcoal" (activated in a highly oxidising atmosphere below 150°), approaching in adsorptive properties hydrophilic silica, when suspended in water, gave only negative particles. It showed both acid and base adsorption. AUTHORS.

**4359. Surface Tension of Vitreous Enamel Frits. W. N. Harrison and D. G. Moore.** *Bureau of Standards, J. of Research*, 21. *pp.* 337–346, *Sept.*, 1938.—A method is described for measuring at high temperatures the surface tension of liquids with viscosities as high as 10,000 poises. It consists of weighing the portion of the liquid supported by the meniscus adhering to a Pt cylinder, the bottom edge of which is at the level of the undisturbed surface of the liquid. The method insures a zero angle of contact and eliminates the necessity of determining the specific gravity of the sample at the temperature of test. Results were in good agreement with those obtained by the bubble-pressure method on molten NaCl and also on a molten "soft" ground-coat frit at a viscosity of 400 poises. The results obtained on eight typical commercial vitreous enamel frits at 850° C. showed, with one exception, maximum differences of less than 10%. The mean value for seven of the frits was approximately 250 dynes/cm., while that for a high lead composition was about 200 dynes/cm. The surface tension in all cases increased with decreasing temperature between 925° and 775° C., the maximum increase being less than 10%. Mill additions had very little effect on the surface tension. AUTHORS.

**4360. Capillary Ascent in Cylindrical Tubes. A. W. Porter.** *Phil. Mag.* 26. *pp.* 519–520, *Oct.*, 1938.—It is shown by writing Poisson's and Rayleigh's capillary height formulæ in non-dimensional forms that the values given by the former formula are always too small, and those given by the latter are too great when $h_o/2r$ is less than about 2, the standard of reference being the tables of Bashforth and Adams. P. H. B.

**4361. Structure of Thin Layers Formed on Single Crystals. R. Uyeda.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 656–666, *Aug.*, 1938. *In English.*—Thin layers of the oxidation product formed at high temperatures on a cleavage face of molybdenite were studied by the method of kathode-ray diffraction. The oxide was identified to be $MoO_3$ and the following two types of orientation were observed: The (111) plane of $MoO_3$ is parallel to the cleavage plane of molybdenite, and the direction normal to it is a fibre axis; The (010) plane of $MoO_3$ is parallel to the cleavage plane of molybdenite, and the (101) plane of the former is parallel to the $(10\bar{1}0)$ plane of the latter. A possible interpretation is given for the new pattern, which was reported previously by the author. AUTHOR.

**4362. Electron Diffraction and Surface Structure. G. I. Finch.** *Chem. Soc., J. pp.* 1137–1147, *Aug.*, 1938.—In this paper the results of all the important applications of electron diffraction to surface structure are reviewed and correlated, whilst some of the author's recent work is described, particular attention being paid to the problems of lubrication and running in. It is shown that in the case of an end-substituted normal paraffin, such as stearic acid, deposited on a plane surface, the long chains are not erect on the surface, as is the case with paraffin, but tilted over to some definite angle, in this case 53°, to the surface, but otherwise pointing in all possible directions. On firmly rubbing such a film in one direction the chains become inclined at about 5° to the surface and towards the

direction of rubbing. No matter how the film is rubbed, the inclination of the chains is determined solely by the last stroke. It is also shown that during running-in with colloidal-graphited oil, minute graphite crystals are, as it were, rolled into the Beilby layer during its formation, and whilst this graphite is frequently not detected at once by electron diffraction, slight etching followed by gentle polishing suffices to afford the characteristic graphite pattern. A. G. Q.

**4363. Structure of Electrolytically Polished Copper Surfaces. K. H. Moore.** *Ann. d. Physik*, 33. 2. *pp.* 133–137, *Sept.*, 1938.—The surface of electrolytically polished Cu was examined by electron diffraction and shown to consist of $Cu_2O$. When the original Cu surface was polycrystalline the oxide film exhibited strong (110) orientation. With an electrolytically polished (110) face of a Cu single crystal, the oxide crystals arranged themselves with a cube edge parallel to the cube edge of the Cu crystal, whilst with the (100) Cu face various orientations were observed. The orientation most frequently observed was (111), the cube face diagonal of the oxide being approximately parallel to the cube edge of the underlying Cu crystal. A. G. Q.

**4364. Structure of Oxide Surface Films. A. Winkel and R. Haul.** *Zeits. f. Elektrochem.* 44. *pp.* 611–619; *Disc.*, 619, *Sept.*, 1938.—Aerosols of Fe prepared by thermal decomposition of $Fe(CO)_5$ in a current of $N_2$ were found to be subject to spontaneous oxidation on exposure to air. By X-rays it was shown that the size of the approximately cube-shaped active particles obtained at 220° C. was 90 Å whilst a short heating to 650° C. gave an inactive substance of grain size about $10^{-3}$ cm. It is pointed out that the properties of the aerosols could be due to lattice distortion or to the development of a very large free surface. The possibility of the existence of lattice distortion in the Fe produced by condensation from the metal vapour phase is thoroughly discussed, but it is concluded that in the present case the pyrophoric properties of the aerosol are to be attributed to the large effective surface area of the specimen. By electron diffraction it is shown that the oxide surface layers formed on the iron films consist of $Fe_3O_4$, and from the results of chemical analysis combined with the original X-ray estimates of the crystal size of the Fe it is concluded that the thickness of these oxide films is 9 Å, or approximately one unit cell of $Fe_3O_4$. In the *Discussion* **R. Brill** states that the authors' conclusions conflict with the work [see Abstract 2924 (1937)] in which he demonstrated the existence of lattice distortion in carbonyl Fe. A. G. Q.

**4365. Construction of Filament Surfaces. R. P. Johnson.** *Phys. Rev.* 54. *pp.* 459–467, *Sept.* 15, 1938.—An incandescent tungsten filament gradually loses its die marks and comes to display a surface whose structure depends on whether the lamp was evacuated or gas-filled, and on whether it was run on a.c. or d.c. Filaments heated *in vacuo* with a.c. remain smooth and nearly round. In neutral gas, with a.c., the filament tends to expose smooth concave (100) faces. The d.c. vacuum structure is steplike, is polarised with respect to the current, and seems to be due to a drift of W ions in the field along the filament. Surface migration of Th adsorbed on W, during d.c. heating, has been demonstrated in a simple electron-optical tube. Structure identical in form with the d.c. structure appears on a.c. filaments where a temperature gradient exists, and is attributable directly to surface diffusion in the temperature gradient. On d.c. gas filaments the d.c. structure and the gas structure are concurrent. No small-scale structure is found microscopically; probably the only sub-

structure is atomic in scale. Preliminary study of Ta, Mo, Pt, Fe and Ni filaments *in vacuo* indicates that these metals also develop a roughened surface on d.c. heating, but remain smooth on a.c. AUTHOR.

**4366. Physical Properties of Cyclo-Pentane, -Hexane and -Heptane and Derivatives. A. I. Vogel.** *Chem. Soc., J. pp.* 1323–1338, *Sept.*, 1938.—The surface tensions and densities over a range of temperatures, and the refractive indices for the C, D, F, and G lines at 20° have been measured for pure *cyclo*pentane, methyl*cyclo*pentane, *cyclo*hexane, methyl*cyclo*hexane, *cyclo*heptane, and the related ketones, alcohols, and unsaturated hydrocarbons, together with a number of methylene compounds. The parachors, molecular refractivities, dispersions, and molecular refraction coefficients have been evaluated. Several forms of methyl*cyclo*hexane have been isolated ; this provides evidence for the multiplanar structure of the simple *cyclo*hexane ring. AUTHOR.

**4367. Temperature Variation of Electron Diffraction Patterns of Organic Films. K. Tanaka.** *Kyoto Coll. Sci., Mem.* 21. *pp.* 85–88, *July*, 1938. *In English.*—Temperature variation of electron diffraction patterns reflected from films of grease, vaseline and paraffins was examined. It was observed that at some elevated temperatures the parallel arrangement of the molecules of the substances is gradually destroyed and with further rise of temperature it becomes haphazard. This transition temperature of the arrangement of the molecules differs with different substances and with different thickness of the films. AUTHOR.

**4368. Nature of Foam. Part I. T. Sasaki.** *Chem. Soc. Japan, Bull.* 13. *pp.* 517–526, *Aug.*, 1938. *In English.*—An apparatus for the measurement of the stability of foam is described and the stability is measured by the height of the foam produced by the air current of a constant velocity. The relation between the velocity of the air current $v$ and the height $H$ of the foam produced was examined and the equation $S \cdot v = H - a$ has been obtained, in which $S$ is the stability of foam and $a$ a constant. The value $a$ is negligible compared with $H$ under the conditions of the present experiments. The measurements of the stabilities were carried out for the aqueous solutions of alcohols and fatty acids, from which several conclusions have been obtained. AUTHOR.

**4369. Properties of Thin Sheets of Noble Metals in Contact with Gases. M. Auwärter and K. Ruthardt.** *Zeits. f. Elektrochem.* 44. *pp.* 579–585, *Sept.*, 1938.—The change point at definite temperature, previously observed in noble metals, when the electric resistance suddenly decreases, is confirmed for Pd and Pt. The " recrystallisation," however, can be induced, although more slowly, by saturating the films with $H_2$ at room-temperature, and continues on washing with $N_2$ or $O_2$. At higher temperatures the resistance suddenly undergoes a large increase, the critical temperatures being different for different gases. From measurements of the selective transmission of light it is deduced that Pd and Pt form compounds with $H_2$ and $O_2$. With thicker non-transparent films, it appears that below a limited depth the compounds of Pd with $H_2$ and $N_2$, and of Pt with $H_2$, $N_2$, and $O_2$, do not penetrate. The superficial coating is compared to a passifying layer. For Pt temperatures at which the resistance suddenly increases are : in contact with $N_2$ 580° C., $H_2$ 580° C., $O_2$ 620° C. ; in the later case the resistance drops from 250 Ω at 160° to 60 Ω at 300° C. owing to recrystallisation. The work is being extended to other metals. D. R. H.

***4370. Inexpensive Surface Tensiometer. H. N. Holmes.** *Science*, 88. *pp.* 223–224, *Sept.* 2, 1938.—Describes a simple tensiometer, based on that of Lloyd and Scarth, combining the ring method with the essential mechanism of the chainomatic balance. It can be built in a few hours at the cost of 4 shillings if a Ni ring is made, and 12 shillings if a Pt ring is purchased. Results within 0·1 dyne/cm. of the true values have been obtained with the apparatus by students. P. H. B.

**4371. Spreading of Liquids in Filter Paper. Part II. K. Prosad and B. N. Ghosh.** *Kolloid Zeits.* 84. *pp.* 275–283, *Sept.*, 1938.—Following up previous work [see Abstract 2985 (1937)] it was found that while the quantity of $H_2SO_4$ adsorbed per unit area is independent of concentration, the corresponding amount of HCl and $H_3PO_4$ increases with concentration. The phenomenon is a complicated one. The curves connecting the speed of spreading with area wetted fall (except for HCl and NaCl) into two or more sections, owing to the formation of hydrates. The part played by surface tension is discussed. P. H. B.

*See also* Abstract 4503.

## TIME.

***4372. Production of Accurate One-Second Time Intervals. W. D. George.** *Bureau of Standards, J. of Research*, 21. *pp.* 367–372, *Sept.*, 1938.—This paper describes the technique wherewith a highly accurate frequency of 1 ~ is obtained for broadcasting from the Bureau's radio station WWV. Multivibrators are used in obtaining lower frequencies from a radio-frequency standard. Observations are given concerning the nature of short-time instabilities occurring in controlled multivibrators. The measuring technique is described whereby the accuracy between successive time intervals or cycles is checked to better than one part in a million. It is pointed out that the arrangement can be used for supplying extremely short pulses accurately spaced in time. The frequency of 1 ~ is added as a modulation on standard radio frequencies, which are broadcast. AUTHOR.

**4373. Programme Selection in Time and Azimuth Determinations. T. Niethammer.** *Bull. géodésique, No.* 56. *pp.* 273–289, *Oct.–Nov.–Dec.*, 1937. *In German.*—The author discusses the principles underlying the determination of clock corrections with a view to choosing the most suitable stars for observation. Certain recent developments in generalising the formulæ involved and in better meeting the requirements of the practical observer are critically examined. A. Hu.

## VISCOSITY AND FRICTION.

**4374. Viscosity Function. E. P. Irany.** *Am. Chem. Soc., J.* 60. *pp.* 2106–2115, *Sept.*, 1938.—Due to insufficient knowledge of the structure of liquids it is impossible to formulate the basic and generally valid laws which relate liquid viscosity with variables of condition, such as volume (dilution), temperature and pressure. In the absence of real proof that such laws of broad validity exist, or that they are recognisable, a method of graphical analysis has been used to provide necessary evidence which has been summarised in three postulates, *viz.*, a function of viscosity exists, $\phi(\eta)$, or the " $\phi$ scale", which is generally additive, (1) in terms of volume, *i.e.*, of dilution in ideal mixtures, (2) in terms of temperature, *i.e.*, temperature and dilution have the same quantitative effects upon viscosity.

(3) Another function $\Pi(\eta)$, or the "$\Pi$ scale," exists, which is generally additive in terms of pressure. When viscosities are plotted in these functional scales, all normal or "ideal" additivity is represented as a straight line, and deviations are very accurately recognisable and significant, *e.g.*, associative or dissociative tendencies are revealed which could not be detected by other means. Extrapolation into the critical region suggests important conclusions regarding state discontinuity. The $\Pi$ scale shows the correct magnitude of the internal pressures of liquids. H. H. Ho.

**4375. Structural Viscosity of Softening Selenium Glass. E. Jenckel.** *Kolloid Zeits.* 84. *pp.* 266–268, *Sept.*, 1938.—Using the apparatus previously described [see Abstract 4786 (1937)], the author investigates the extension of rods of Se glass under different stresses at temperatures of 29·60, 31·35 and 34·73° C. It is found that the viscosity diminishes with increasing stress. The diminution can be represented well by means of a formula given by Philippoff, but the constant $\gamma$ of this formula does not possess the significance of a modulus of elasticity. L. A. W.

**4376. Viscosity of Air. V. D. Majumdar and M. B. Vajifdar.** *Indian Acad. Sci., Proc.* 8*A*. *pp.* 171–178, *Sept.*, 1938.—Using a modified form of Wagstaff's apparatus for measuring the coefficient of viscosity of air by the method of interference fringes and using capillary tubes, the value of $\eta_{23°C}$ has been found to be $(1834{\cdot}38 \pm 0{\cdot}35) \times 10^{-7}$ c.g.s. units. The value of the electronic charge, $e$, calculated with this value of $\eta$ is $4{\cdot}816 \times 10^{-10}$ e.s. units. Both these values are in close agreement with those obtained recently by other workers using different methods. Authors.

**4377. Effect of Pressure on Viscosity of Boric Anhydride Glass. E. B. Dane, Jr., and F. Birch.** *J. of Applied Physics*, 9. *pp.* 669–674, *Oct.*, 1938.—The effect of pressure on the viscosity of $B_2O_3$ glass has been determined by a high-pressure capillary flow method up to about 2000 kg./cm$^2$., at two temperatures, 516° and 359° C. The results are satisfactorily represented by the expression $\eta = \eta_0 e^{\alpha p}$, with $\alpha = 4.6 \cdot 10^{-4}$ cm$^2$./kg. at 516°, $\alpha = 15 \cdot 10^{-4}$ cm$^2$./kg. at 359° C. The ratio of the viscosity at 1000 kg./cm$^2$. to the viscosity at 1 atm. is therefore 1·58 at 516°, 4·48 at 359°. The results are briefly compared with those for organic liquids. Authors.

# ASTRONOMY AND ASTROPHYSICS.

## ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***4378. Transit Instruments. W. H. Rayner.** *Univ. of Illinois Eng. Exp. Sta., Circ. No.* 32. [17 *pp.*], *May* 17, 1938.—Two investigations are described one dealing with a comparison of transit verniers, the other with the relation between line of sight and axis of objective slide in transit telescopes. Various conclusions are drawn concerning the accuracy of such verniers whilst in the second case it is found that save in very exceptional cases the adjustment for this condition is unimportant. A. H.

***4379. Pretoria 74-in. Reflector.** *Engineer*, 166. *pp.* 298–301, *Sept.*, 16; 326–328, *Sept.* 23, *and pp.* 353–354, *Sept.* 30, 1938.—This

telescope is similar in design to the Dunlap and Greenwich types having the " English " type lattice-work tube ; the mirror's parabolic surface will have accuracy of about $10^{-6}$ in. ; its support is such as to avoid distortion whatever the mirror position. The hollow steel polar and declination axes are described ; the slow motions have two speeds. The constant-speed system is based on McMath's method at the Hulbert Observatory, Michigan, but instead of an oscillator, it will have a thermionically controlled tuning fork, made of elinvar without contacts, arranged in a constant temperature chamber. The housing consists of a rotating, cylindrical steel-work turret mounted on top of a concrete base. The turret has an outside diameter of 61 ft. The observing carriage is of novel design, and is built of steel angles and plates. Its basis is a vertical steel frame, 27 ft. by 10 ft. wide and is arranged to travel round the inside of the turret except past the 15 ft. observation gap. A. S. D. M.

## COMETS AND METEORS.

*See* Abstracts 4416, 4417.

## COSMOGONY.

**4380. Curvature of Space and the Limited Dimensions of the Stars. L. Laboccetta.** *Ricerca Scientifica*, 2. *pp.* 33–37, *July*, 1938.—It follows from the theory of relativity that the curvature of space, due to the presence of matter, limits the dimensions of a sphere of given density. In classical physics there corresponds to every density a time which is independent of the dimensions of the sphere. It is shown that for this time the mass and radius of a sphere, the normal sphere, remain finite if the velocity of light is chosen as limiting velocity. This time is the eigen-time of the sphere. The sphere can be characterised by a characteristic number which varies with the chosen system of units and is related to the eigen-time. For a sphere of the density of water the eigen-time corresponds to Maxwell's absolute unit of time and is proportional to Lippmann's natural hour. [See following Abstract.] L. K.

**4381. Eddington's Relation between Radius of Electron and Radius of Universe. L. Laboccetta.** *Ricerca Scientifica*, 2. *pp.* 164–166, *Aug.*, 1938.—It was shown [see preceding Abstract] that the normal sphere is defined by a characteristic number which indicates the number of elementary particles forming the sphere. In this paper the author considers the case that the characteristic number is equal to the square of the cosmical constant $\psi^2$, and shows that Eddington's relation, that the cosmical constant is the ratio between the radii of the universe and of the electron, follows immediately. Furthermore, the author derives relations between the mean free path of a proton in the universe and the cosmical constant and the electronic radius, and between the gravitational constant, the mass of the universe and its radius. L. K.

**4382. Origin of Planets. J. H. Jeans.** *Science and Culture*, 4. *pp.* 73–75, *Aug.*, 1938.—The author names the planetary theories formed from Descartes (1644) to Laplace (1796), discussing the latter's which considered that Saturn's rings were pre-natal ; Roche (1852) is, however, conclusive that they are post-mortal. He describes his own tidal theory, propounded in 1916, and takes up the difficulties found by Jeffreys in this and all others which suppose that the planets originally formed part of the sun. Of such are Bickerton's, H. N. Russell's, Lyttleton's and Milne's. He concludes that though questions of rotation introduce

certain difficulties into this tidal theory of his own, its many successes suggest that it is fundamentally on sound lines. A. S. D. M.

*See also* Abstract 4350.

## DYNAMICAL PROBLEMS (ASTRONOMICAL).

**4383. Equilibrium of Fluid Masses. R. Wavre.** *Comptes Rendus*, 207. *pp.* 460–462, *Sept.* 5, 1938.—The method of Volterra, by which it is proved that certain stratifications of the equilibrium figures of heterogeneous fluid masses cannot occur, is generalised by means of the theory of implicit functions. Dive's result that stratification in concentric ellipsoids is impossible for barotropic rotation is obtained in a simpler way, and an extension of the theorem to other forms of stratification is derived. A. Hu.

## LATITUDE AND LONGITUDE.

**4384. Variations of Latitude. L. Carnera.** *Accad. Lincei, Atti*, 27. *pp.* 421–426, *May* 1, 1938.—The author tabulates the results from the observations of the coordinates of the pole. The observations have been made in five stations on the northern hemisphere in 1936 and 1937, and in two stations on the southern hemisphere. The author shows that the error in the determination of the variation of the latitude is of the same order as the periodical variations which shall be determined. It follows that astronomical instruments of a much higher degree of accuracy are wanted if the studies of local variations of a periodical character are to be continued. L. K.

## NEBULÆ.

**4385. Physical Processes in Gaseous Nebulæ. Part IV. D. H. Menzel, L. H. Aller and J. G. Baker.** *Astrophys. J.* 88. *pp.* 313–318, *Oct.*, 1938.—The statistical equilibrium of nebulæ has been discussed in the past from two points of view. H. H. Plaskett employed a *mechanistic* argument, where the captures in a given level are subdivided according to the probability of transitions to lower levels and are followed through successive transitions down to the ground level. Carroll criticised Plaskett's treatment and developed equations on an *equilibrium* argument. The authors have shown that the two points of view, when properly applied, lead to the same result, and have derived the necessary equations, which will lead to a determination of electron temperature. [For Part III see Abstract 3137 (1938).] Authors.

**4386. Characteristics of Associated Galaxies. Part I. Density Restriction in the Metagalaxy. E. F. Carpenter.** *Astrophys. J.* 88. *pp.* 344–355, *Oct.*, 1938.—The densities of distribution of galaxies in 42 metagalactic groups and clusters have been computed. The fundamental data were drawn chiefly from descriptions published at the Harvard and Mount Wilson Observatories. Distances of the latter set have been correlated with the red-shift, while distances of the former are entirely photometric, but results from both sources are consistent. Analyses of partly observed memberships of clusters are believed to furnish estimates of the total membership with sufficient accuracy for this investigation. The study shows that the smaller a cluster is, in dimensions and membership, the greater its density may be. The distribution of clusters in the

density-volume diagram is bounded by the fairly well-defined envelope $\rho_{max} = 4400/\sqrt{V}$, and suggests that the conventionally recognised clusters of galaxies are not separate metagalactic entities but are merely the extremes of a nonuniform space distribution conditioned by the above-mentioned density restriction. The foregoing value of the constant of proportionality results from the adoption of $-14{\cdot}2$ as the average absolute magnitude of a galaxy. AUTHOR.

**4387. Diffuse Nebulæ and Cosmic Absorption. V. A. Ambarzumian and S. G. Gordeladse.** *Abastumani Astrophys. Obs., Bull.* 2. *pp.* 37–52, 1938. *In English.*—The luminosity of a diffuse nebula is connected with some neighbouring star of large absolute brightness; the associated star may be either dynamically connected with the nebula or may be only temporarily in its neighbourhood. A statistical investigation of the distribution of nebulæ and stars of various types leads to rejection of the hypothesis of dynamical connection of nebula and bright star and tends to prove that the diffuse nebulæ accidentally meet their erstwhile associated stars in space; this leads to the conclusion that a large multitude of unilluminated diffuse nebulæ exists with random space distribution. Calculation shows that the magnitude of the absorption expected of such nebulæ agrees in order of magnitude with general absorption data; they are therefore presumably responsible for the absorption. On this basis no correlation is expected between the local surface brightness and selective absorption in the Milky Way. Emission nebulæ and " dark " nebulæ are both regarded as of the same fundamental type; diffuse nebulæ not illuminated by bright stars are " dark " nebulæ, diffuse nebulæ illuminated by B1 to M stars simply reflect their light and diffuse nebulæ illuminated by O and B0 stars give the emission spectrum. J. E. K.

## PLANETS.

**4388. Photoelectric Light-Curve of Eros. F. E. Roach and L. G. Stoddard.** *Astrophys. J.* 88. *pp.* 305–312, *Oct.*, 1938.—Photoelectric observations of Eros made on Feb. 4–5, 1938, when the earth was in or near the asteroid's equatorial plane, are presented. A new analysis of the form and size of Eros, following Krug and Schrutka-Rechtenstamm, leads to a three-axis ellipsoid with axes of $35{\cdot}0$, $15{\cdot}6$, and $7{\cdot}2$ km. AUTHORS.

**4389. Problem of Lunar Changes. W. H. Haas.** *Roy. Astron. Soc. Canada, J.* 32. *pp.* 347–352, *Sept.*, 1938.—The author tries to decide between incident light and physical change for lunar variation. He classifies these as (*a*) dark areas, (*b*) bright spots, (*c*) colours: for the times (1) 2 days from sunrise, (2) at sunrise, (3) at sunset, and for colours in addition, differences in darkness seen in shadows. He discusses these and the additional effects due to libration. He forms intensity curves, by plotting the intensity of a marking against the co-longitude. These curves can also be used to investigate the structure of the moon's surface if the lunar changes could be explained by incident light theory. For instance, photographs of Aristarchus in different wave-lengths indicate that its rock is sulphur-coated. The two theories could be tested in a lunar eclipse; on the incident light theory, an eclipse should have no effect in detail. A. S. D. M.

*See also* Abstracts 4338, 4382.

## STARS.

**4390. Spectrum of γ-Cassiopeiae. J. F. Heard.** *David Dunlap Obs., Comm. No.* 2. *Roy Astron Soc. Canada, J.* 32. *pp.* 353–356, *Sept.*, 1938.—The author traces qualitatively the variations from 1937–1938 Aug., and measures the displacement of emission lines of H, ionised Fe, He, also ionised Ca, Mg, Si, Ni, Cr and Sc, all showing structure and variations similar to those of ionised Fe. No absorption lines were seen in 1937, but in 1938, ionised O and doubly ionised Si lines were seen, but weakening in July and Aug. A table is given of radial velocity measures. A. S. D. M.

**4391. Lines of Ionised Barium in Stellar Spectra. C. G. Burwell.** *Mt. Wilson Observat. Contrib. No.* 598. *Astrophys. J.* 88. *pp.* 278–284, *Oct.*, 1938.—Five A-type stars have been found in which the red triplet of Ba II is abnormally intense. All data agree that these stars are somewhat fainter than the average of the main sequence, although in later types Ba II is strong in giant stars. This behaviour of Ba II may be similar to that of Sr II in the F0 Sr " dwarfs." A brief comparison of the behaviour of Ca, Sr, and Ba is given. AUTHOR.

**4392. Relationship Between Colour, Spectrum and Absolute Magnitude for G-Type Stars. J. S. Hall.** *Astrophys. J.* 88. *pp.* 319–343, *Oct.*, 1938.—The colours and magnitudes of 170 bright HD G-type stars have been determined with a photoelectric photometer, sensitive to the infra-red, at the Sproul Observatory. A null method involving the use of two photo-cells was used to make 36% of the observations. It is briefly described. Accurate colour excesses were formed from a combination of these data, Becker's colours, and Hertzsprung's photographic magnitudes with accurate spectral types. These colour excesses are strongly related to the Victoria spectroscopic absolute magnitudes for stars of spectral class G2 to K0. The presence of red secondary components to several close visual binaries is strongly suggested by (1) a comparison of the blue-violet with the red-infra-red colours and (2) the unusually large differences (of the proper sign) between the Victoria and the colorimetric absolute magnitudes. The data suggest that two nearby stars not known to be binaries may have red companions. The colours of stars of spectral types F8 to G1 of the main sequence are found to show very little cosmic dispersion. This conclusion confirms that very recently formulated by W. W. Morgan [see Abstract 3452 (1937)]. AUTHOR.

**4393. Spectrum and Radial Velocity of γ Persei. D. B. McLaughlin.** *Astrophys. J.* 88. *pp.* 358–359, *Oct.*, 1938.—The K line of Ca II in this composite spectrum shows variations in velocity opposite to those of the solar-type spectrum. A period of about ten years is suggested. AUTHOR.

**4394. Displacements of Absorption Lines in the Spectrum of P Cygni. E. K. Kharadse.** *Abastumani Astrophys. Obs., Bull.* 1. *pp.* 39–46, 1937. *English Abstract.*—In previous investigations of the displacements of absorption lines in stellar spectra consideration appears never to have been given to the influence of neighbouring bright emission on the contour and displacement of a dark component. The existence of such an influence is confirmed in an investigation of the P Cygni spectrum and its amount is determined ; when due allowance is made for this influence corrected values are obtained for the radial velocities of the absorption lines. Examination of the corrected data shows that Struve's correlation between radial velocities and ionisation potentials [see Abstract

638 (1935)] is undoubtedly real but that the correlation between radial velocities and intensities either does not exist or is extremely weak. J. E. K.

**4395. Compilation of Data for Stronger Lines in α Cygni Spectrum. A. B. Wyse.** *Lick Observat., Bull. No.* 492. *pp.* 129–162, 1938.—The author has collected a part of the available material of Cygni (spectral Class A2p) for his own use, revising the laboratory identifications of the lines so as to make the list as homogeneous as possible. The similarity of α Cygni's spectrum to the absorption spectra of temporary stars when near their maxima makes it valuable to other investigators of Novae. He gives the sources of the identifications and describes the table which occupies pages 132–162. A. S. D. M.

**4396. Relative Energy Distribution in the Continuous Spectrum of 36 Fundamental Stars. H. Kienle, H. Strassl and J. Wempe.** *Zeits. f. Astrophysik*, 16, 4. *pp.* 201–275, 1938.—The spectra of 36 fundamental stars have been photometrically measured with two different objective-prism cameras and were brought into connection with each other. The photometric measurements which were carried out by means of wire gratings are chiefly discussed. The mean values of the directly observed connections are tabulated together with the relative energy distributions referred to the A0-stars. The differences of both instrumental systems and the deviations of the magnitudes from a linear function of $1/\lambda$ are shown in diagrams. L. K.

**4397. Two Elementary Theorems on Polytropes. N. R. Sen.** *Calcutta Math. Soc., Bull.* 30. *pp.* 11–16, *March*, 1938.—The maxima and minima of two invariants of homology associated with Emden's equation are discussed. G. C. McV.

**4398. Galactic Structure in Taurus. Part I. Surface Distribution of Stars. S. W. McCuskey.** *Astrophys. J.* 88. *pp.* 209–227, *Oct.*, 1938.—In order to study the structural features of the galaxy toward the anti-centre general star counts to photographic magnitude 15 have been made in an area of 600 square degrees in Taurus between $\alpha$ $2^h40^m$ and $5^h40^m$ and $\delta$ + 20° to + 35°. The magnitude scale corresponds essentially to the International Photographic Scale, although there may be a systematic difference amounting to possibly 0·2 mag. for the brightest stars. The surface distribution of stars in arbitrarily selected regions of little or no obscuration is given and is compared with similar data by others. It is found that these areas exhibit an excess of 0·2 in log N($m$) over the data published by van Rhijn and by Sears and Joyner. An examination of the plates shows that this excess is undoubtedly due to the obscuring nebulosity overlying the Selected Areas on which previous stellar distributions in this region have been based. With the mean values of log N($m$) in the clear areas as a basis, the amount of absorption of photographic light at magnitude 15 has been determined for small subareas, the distribution being shown by a chart and by a contour map. The total absorption at the fifteenth magnitude in the condensations of the Taurus region reaches values as high as 3·5–3·7. mag. Over much of the region the obscuration amounts to 1·5–2·5 mag. The stellar space density in Taurus and a discussion of the dark nebulae will be presented in a succeeding paper. AUTHOR.

**4399. Space Distribution of F-Type Stars. M. A. Vashakidse.** *Abastumani Astrophys. Obs., Bull.* 1. *pp.* 87–96, 1937. *In English.*—The distribution of F-stars in the direction perpendicular to the galactic plane is computed. The material used comprises stars down to the 12th

magnitude in 14 Kapteyn areas of the southern hemisphere between galactic latitudes 31° and 73°. The absolute distribution of star density as derived is illustrated by a curve showing the number of F-stars per cubic parsec in dependence on Z ; at a distance of 600 parsecs the density decreases by a factor of 10. It is found that the density of stars in the direction perpendicular to the galactic centre is constant but in the direction opposite to the galactic centre the density is not uniform. [See following Abstract.]

J. E. K.

**4400. Distribution of A, F and G Type Stars Perpendicular to the Galactic Plane and in the Direction to the Galactic Centre. M. A. Vashakidse.** *Abastumani Astrophys. Obs., Bull.* 2. *pp.* 109–127, 1938. *In English.*—A previous investigation on the distribution of F-type stars [see preceding Abstract] is extended to A, F and G stars ; the stars are those classed in Schwassmann's catalogue in Kapteyn areas 4, 5, 6, 8, 9, 11–16 and 19 of the northern hemisphere, nine of the areas in different galactic latitudes are used in deducing the distribution in the $z$ direction (to the pole of the galaxy), the 3 areas, 8, 9, 10, are used in deducing the distribution in the $c$-direction (to the galactic centre). It is assumed that the equi-density layers are plane-parallel and parallel to the galactic plane. The calculated data connecting Nm, the number of stars per degree$^2$ brighter than magnitude $m$, with $m$ are presented in tabular and graphical form. The luminosity functions are derived from material catalogued by Adams and others [see Abstract 1490 (1935)] in the case of A and F stars and by van Rhijn and Schwassmann [see Abstract 3358 (1935)] in the case of G stars. Curves and tables are given of the density D as a function of $z$ and of $c$; the distribution agrees satisfactorily in the case of F and G stars with that derived by van Rhijn and Oort. J. E. K.

**4401. Emission Nebulosities in Cygnus and Cepheus. O. Struve and C. T. Elvey.** *Astrophys. J.* 88. *pp.* 364–368, *Oct.*, 1938.—Several extended regions in Cygnus and Cepheus are enveloped in diffuse nebulosities which show H$\alpha$ and [O II] 3727 in emission. These nebulosities are usually not concentrated toward individual bright stars, and it is probable that they derive their light from the u.v. radiation of the integrated O and B stars in Milky Way star clouds. The faintest nebulosities observed require about 10 atoms of H in the third quantum level, in a column of 1 cm$^2$. cross-section. A rough computation shows that this interstellar H has a density corresponding to 0·01 atom per cm$^3$. AUTHORS.

**4402. New Southern Double Stars. (Third List.) R. A. Rossiter.** *Roy. Astron. Soc., Mem.* 66. 1. *pp.* 1–9, 1938.—[See also Abstract 524 (1936).]

**4403. Quadruple System, 59 Serpentis. R. Tremblot.** *Comptes Rendus*, 207. *pp.* 491–493, *Sept.* 19, 1938.—This star (of visual magnitudes, 5, 5, 7, 8) has a very slow orbital motion and is a double spectroscopic system with notable eccentricity and long period. 12 spectrograms have been obtained between July 15th and Aug. 8th, 1938, confirming the characteristics given in the Draper catalogue. The author concludes that it should be considered a quadruple star, behaving like 3 bodies in rapid motion. This is the fourth example of a star belonging to the Harvard composite type classification, recognised as a spectroscopic triple and showing lines of several constituents. A. S. D. M.

**4404. Spectroscopic Triple Star 59d Serpentis. D. B. McLaughlin.** *Astrophys. J.* 88. *pp.* 356–358, *Oct.*, 1938.—This star is composed of a close pair of nearly equal stars of class A having a period

of about 2 days, and a distant G-type companion having a probable period of 15 years. The spectroscopic triple is the brighter component of a wide visual double. AUTHOR.

**4405. Present Spectral Characteristics of Sixteen Old Novæ. M. L. Humason.** *Mt. Wilson Observat. Contrib. No.* 596. *Astrophys. J.* 88. *pp.* 228–243, *Oct.*, 1938.—Spectra of 16 old novæ have been observed with a small-dispersion spectrograph. Observations have been made in the fields of two others in an effort to identify them by their spectra. Visual magnitudes of the observed objects range from 10·0 to 16·5. Charts of all the fields are given for the benefit of other observers. Most of the objects have a strong continuous spectrum extending well into the violet, in which neither absorption nor emission lines can be seen. They have therefore been classified as O Con, since the extension into the violet corresponds to that of O-type stars, or possibly of early B stars. When emission lines have been observed, the stars have been classified as O Em. In the search for Nova B Cassiopeiæ (1572), Baade observed an interesting faint blue star on a colour plate of the region. Its photographic magnitude is 17·0, its spectrum A0*n*. As the mean absolute magnitude for stars of this type is roughly + 1·0, the distance modulus, uncorrected for space absorption, is 16·0, thus indicating a distance of the order of 25,000 parsecs in a direction 125° from that of the galactic centre. It is not assumed that this star is the nova. Spectral types of four stars observed in the field of Nova Vulpeculæ (1670) indicate that this nova has not yet been rediscovered. One of these objects is the faint variable star found by W. H. Steavenson. With the exception of T Coronæ, all the novæ observed are blue and probably correspond in temperatur- with the O or early B stars. T Coronæ may also be blue if it is the come panion of a red star. The density of Nova Persei (1901) in its present state is of the order of 220 ⊙. The corresponding value for Nova Aquilæ (1918) is 70 ⊙. For eleven novæ whose distances are not so reliably known, a mean density has been determined by using $M_{max} = -7{\cdot}0$, the mean $M$ of galactic novæ at maximum, from which their present mean $M$ is obtained by adding the mean of their amplitudes. The resulting mean density of this group is 60 ⊙. AUTHOR.

**4406. Absolute Photographic Magnitude of Supernovæ. W. Baade.** *Mt. Wilson. Observat. Contrib. No.* 600. *Astrophys. J.* 88. *pp.* 285–304, *Oct.*, 1938.—A compilation of the photometric data for the 18 supernovæ known at the end of 1937 is given. Former estimates have been replaced by photometric magnitudes after a redetermination of the magnitudes of comparison stars on the international system. The mean absolute photographic magnitude of the supernovæ, derived from this material, is $\overline{M}_{max} = -14{\cdot}3 \pm 0{\cdot}42$ (m.e.) with a dispersion $\sigma_{Mmax} \approx 1{\cdot}1$ mag. This result, together with the spectroscopic evidence, fully confirms the view that two classes of novæ, common novæ and supernovæ, exist. Attention is drawn to the curious fact that 72% of the known supernovæ appeared in late-type spirals. B Cassiopeiæ and the Crab nebula, which may have been galactic supernovæ, are discussed. AUTHOR.

**4407. Mass Ejected during Nova Outburst. S. G. Gordeladse.** *Abastumani Astrophys. Obs., Bull.* 1. *pp.* 55–85, 1937. *English Abstract.*—Three independent methods are used for estimating the mass ejected during the outburst of a typical nova, 8 of the better-known novæ being studied for the purpose. The results confirm that the assumption of an

ejection from the surface of the star of a finite amount of matter accounts satisfactorily for the main maximum and the subsequent sharp fall in brightness. The mass ejected depends on the absolute magnitude at maximum. The relatively slow decrease of brightness suggests that an instantaneous ejection is accompanied by a continuous outflow from the surface into space. This is confirmed by the similarity of the spectra of late novæ with Wolf-Rayet spectra. Secondary eruptions account for the subsequent small maxima. The ejected mass is least for stars which are faintest before outburst. The geometrical similarity at some stages between novæ and planetary nebulæ is discussed, and it is suggested that only supernovæ retain a permanent envelope and become planetary nebulæ. A. Hu.

**4408. Final-Phase Temperatures of Novæ. S. G. Gordeladse.** *Abastumani Astrophys. Obs., Bull.* 2. *pp.* 69–97, 1938. *English Abstract.*—Zanstra's method for determining the temperatures of Wolf-Rayet stars is considered with a view to applying it to novæ in their final stages of outburst. The model examined consists of a star surrounded by a gaseous envelope of small radius containing atoms in 4 quantum states. The total amount of Balmer quanta formed in the envelope depends not only on the u.v. radiation of the central star in the Lyman continuum but also on that in the Balmer continuum. The importance of the latter effect depends at a given temperature on the ionisation potential: it is large at low temperatures (12,000° C.) for He and $He^+$ and for H. For different initial spectral lines, different temperatures are obtained corresponding to their excitation potentials. The reliability of the high temperatures obtained is therefore questionable. Thence the theory that the density increases during the outburst is not necessary to explain the fact that the final brightness differs little from the initial. A. Hu.

**4409. Energy Liberated during Nova Outburst. S. G. Gordeladse.** *Abastumani Astrophys. Obs., Bull.* 2. *pp.* 99–107, 1938. *English Abstract.*—The energy liberated during an outburst must suffice to overcome the gravitational attraction between the star and the ejected envelope, to endow the envelope with kinetic energy, and to provide the radiation during the outburst. These 3 quantities are computed for a typical nova. The condition that the energies concerned should be of the same order of magnitude as one another is better satisfied by assuming a continuous outflow than by an instantaneous ejection. The energy of the outburst is of the order of $10^{44}$ to $10^{46}$ erg. A. Hu.

*See also* Abstracts 4387, 4413, 4414, 4463, 4473.

## SUN.

**4410. Solar Prominences. Part I. M. Waldmeier.** *Zeits. f. Astrophysik*, 16. 4. *pp.* 276–290, 1938.—A statistic is given of the solar prominences which have been observed in the years 1936 and 1937. The size, mean life and number of prominences have been investigated. The greatest number of eruptions occurs in a distance of 20°–30° from the central meridian of the sun; there is a strong decrease on the limb. With very few exceptions the prominences are observed in groups of sunspots, and they show a tendency to appear in the same places. The number as well as the intensity of the prominences depends on the type and the phase of development of the corresponding sunspots. The author shows that the number of coincidences of prominences in widely distant groups of spots is not greater than can be expected. L. K.

**4411. Prominence Studies. R. R. McMath and E. Pettit.** *Mt. Wilson Observat. Contrib. No.* 597. *Astrophys. J.* 88. *pp.* 244–277, *Oct.*, 1938. —Data for seven new eruptive prominences confirm the laws of motion previously stated. The end velocity is now shown to revert occasionally to a whole multiple of the second preceding velocity, which explains some apparent exceptions to the second law. One prominence reached the unparalleled height of 1,550,000 km. and another the record velocity of 728 km./sec. The former was near the north pole of the sun. A calculation of the Milne effect shows that we cannot assume that light-pressure balances gravity at the sun's surface. Velocities of more than 100 km./sec. are developed in a few minutes from an initial 10 km./sec. velocity. Ca tends to separate widely from H. The motions in the fountain-like loops of class III*b* prominences are down both branches from the ends of the bright tops of the arches. Practically all obey the first law, and about 20% the second law of prominence motion ; 7 cases show no change in velocity. Small faint lumps of chromospheric matter are sometimes ejected from a spot area, at considerable angles to the vertical. These ejections seem to move in nearly straight trajectories and do not return. Examination of the dissolution of an active prominence projected on the disc shows that centres of attraction are not visible as surface markings. With one exception, prominence streamers have always been seen to enter centres of attraction from one side only. 50% of all the streamers from class I prominences measured followed both laws of prominence motion. When a centre of attraction becomes very active, long streamers not connected with the active prominence enter the centre of attraction from great heights. These seem to come from space in the middle or outer corona. They obey both laws of motion of eruptive prominences. AUTHORS.

**4412. Dimensions of Solar Granules. P. C. Keenan.** *Astrophys. J.* 88. *pp.* 360–364, *Oct.*, 1938.—From observations in visual light the average diameter of the larger granules which are ordinarily observed is estimated at 1″·4, or 1100 km. Their centres are spaced about 1500 km. apart, so that they occupy about 35% of the surface area of the sun. Their total number at any moment is roughly 2,600,000. AUTHOR.

**4413. Stellar Groups Moving with the Sun. L. Gialanella.** *Accad. Lincei, Atti*, 27. *pp.* 403–409, *April* 24, 1938.—The author continues his study of the statistics of the two stellar groups moving parallel to the sun [see Abstract 1536 (1938)]. He has calculated the cartesian coordinates of the 122 stars and their absolute magnitudes. The results are tabulated and shown in a diagram. The stars are arranged in an open cluster. There is no indication of the twofold plane stratification of Horn. 35·8% of the stars belong to the spectral type A, 11·4% to B, 16·2% each to F and G while K is represented by 15·4% and M by 4·0%. It is furthermore shown how the stars of the first and second group are distributed among the spectral types, and a statistic of the mean spectral velocities and the absolute magnitudes is given. L. K.

**4414. Occurrence of Metallic Absorption in Celestial Spectra. L. Biermann.** *Zeits. f. Astrophysik*, 16. 4. *pp.* 291–296, 1938.—The work of Minnaert and v. d. Briel [see Abstract 2350 (1938)] is reviewed from the theoretical standpoint. The author surveys the possibility of theoretically calculating the continuous absorption coefficients needed for deciding whether or not continuous metallic absorption should be expected in the spectra of the sun or stars. The necessary accuracy demands the use of quantum-mechanical methods, as yet unperfected, for calculating oscillator

strengths which are at present undetermined. On the experimental side, an unobjectionable answer to the question can only be given when photometric measurements of the continuous spectrum have been made over wave-length regions as yet unexplored. A. Hu.

**4415. Solar Magnetism. V. C. A. Ferraro.** *Observatory*, 61. *pp.* 241–247, *Sept.*, 1938.—The author first reviews the discovery of sunspot and general magnetic fields in 1908 and 1913, and gives their characteristics; second, the theories of Chapman and Gunn in 1928, and of Cowling showing that the effects are spurious on which these theories were based; third, the non-uniform rotation of the sun and its magnetic field. He states that if a general solar magnetic field exists, it is unlikely that it is radially limited to the extent suggested by the 1913 observations. He gives the chief features of the sun's magnetic field; discusses Larmor's suggestion that this field is due to electric currents flowing in horizontal circuits around the spot, and Cowling's criticism of this; also Cowling's suggestion of its production by horizontal distortion of the general field of the sun by the motion of sunspot gases. He supports Bjerknes' qualitative theory of sunspots. A. S. D. M.

**4416. Astrophysics at North Pole. B. G. Fessenkoff.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 8. *pp.* 605–606, 1938. *In French.*—Suggestions for observation during the polar night are made (*a*) of the behaviour of atmospheric $O_3$ under photochemical reactions to u.v. solar light; (*b*) of night sky luminosity, since its continuous spectrum varies photographically by 300% whilst its visual light is more constant; (*c*) of its line 5577 which varies regularly during the night, reaching a maximum shortly before midnight, and photometric observations should be made both by photography and by eye; (*d*) of the zodiacal light by the same visual method (a radioactive wedge photometer). This is always visible at the north pole in a clear sky as a large luminous band spread out at the horizon, and having two wings. As this is composed of interstellar meteoric material its density cannot be constant; (*e*) of counts to be made both telescopically and by eye of the number of meteor trails. A. S. D. M.

## ZODIACAL LIGHT AND GEGENSCHEIN.

**4417. Origin of Zodiacal Light. B. G. Fessenkoff.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 677–679, 1938. *In French.*—The author investigates the origin and nature of the cosmic particles which are accumulated in the plane of the ecliptic near the sun and which cause the zodiacal light. The variation of particle density $\Delta$ with radius vector $r$ follows the formula $\Delta \sim r^{-k}$, where $k$ is approximately 0 for galactic meteors penetrating the solar system with hyperbolic velocities, $k \leq 1$ for elliptic meteors arising from parabolic comets captured by Jupiter, $k \geq 1$ for elliptic meteors emitted by a planet, $k = 2$ approximately for electronic particles continuously expelled from the sun. The observed variation of density in zodiacal matter corresponds most closely to the third case. It is deduced that meteorites originate inside the solar system. A. Hu.

*See also* Abstract 4416.

# GEOPHYSICS.

## GEODESY.

**4418. Equatorial and Meridional Moments of Inertia of the Earth. N. Mihal.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 689–692, 1938. *In German.*—The paper is wholly mathematical. R. S. R.

*See also* Abstract 4336.

## HYDROSPHERE, PHYSICS OF THE.

**4419. Periodic Oscillations of Annual Mean Sea-Level and Their Relations with Climate. J. Legrand.** *Bull. géodésique, No.* 56. *pp.* 247–272, *Oct.–Nov.–Dec.*, 1937.—The nature of the problem is first considered and thereafter the method adopted in the investigation outlined. The periodic oscillations here considered are deduced from observations at different points in the oceans over the earth's surface. On a large series of charts are set out the results arrived at. These deal with observations in some cases extending for periods of 50 years and over. The author considers that from the investigation it is possible to state that there exists (1) a multiplicity of waves of the same period causing the maxima or minima of the annual mean levels, (2) a specialisation of certain rhythms, if not certain periods, in regions far distant the one from the other, (3) a doubt as to the existence of long periods. The direction in which investigation may be extended is indicated, while it is also pointed out that definite results for predication in changes of climate demand systematic research, a work for which, in the author's opinion, the Corps of the colonial meteorologists is particularly qualified. A. E. M. G.

**4420. Effect of a Travelling Atmospheric Disturbance upon the Sea Surface. T. Takegami.** *Kyoto Coll. Sci., Mem.* 31. *pp.* 55–74, *May*, 1938. *In English.*—The effect of a travelling cyclone on the surface of the sea, taking into account the presence of a coast, is investigated. The theory agrees reasonably with observations of abnormally high water caused by cyclones. W. A. R.

**4421. Tides in Oceans Bounded by Meridians. Part III. A. T. Doodson.** *Roy. Soc., Phil. Trans.* 237*A*. *No.* 779. *pp.* 311–373, *June* 10, 1938.—Continuing previous work [see Abstract 4092 (1936)] a solution of the semidiurnal tidal problem has been reached for an ocean bounded by a complete meridian and is illustrated for twenty values of the depth of the ocean. The genesis and development of amphidromic systems, as the depth changes, can be traced. The possible systems of cotidal lines are of great variety. W. A. R.

**4422. Ra and Rn Content of Pacific Ocean Water, Life, and Sediments. Robley D. Evans, A. F. Kip and E. G. Moberg.** *Am. J. Sci.* 36. *pp.* 241–259, *Oct.*, 1938.—The authors have measured the Ra content of sea water from the Pacific and Atlantic coasts of the United States. In all cases the results are several orders of magnitude lower than those obtained by previous workers. Instrumental reasons are given for regarding the lower results (*ca.* $10^{-16}$ gm./cm$^3$. Ra) as correct. A large increase in Ra concentration with depth in the ocean has been found at several stations. This suggests that Ra is being continuously precipitated out of the ocean. The bottom mud in quiet deep water shows a high Ra content, mainly due to high radioactivity af the finest particles in the

sediment. These fine particles are possibly organic, and as further evidence that biochemical precipitation processes play an important rôle in ocean chemistry, the Ra content of a few marine plants and animals is shown to be of the order of 100 times that of the water in which they live. The oceans must be more widely sampled and many more analyses must be made before the problems of oceanic Ra chemistry may be completely solved, but the general character of the results is becoming clearer.

AUTHORS.

*See also* Abstract 4423.

## LAND, PHYSICS OF THE.

**4423. Internal Structure of the Globe; Origin of Continents and Oceans. A. Dauvillier.** *Comptes Rendus*, 207. *pp.* 452–454, *Aug.* 29, 1938.—The earth is regarded as consisting of a central ferro-nickel (11% Ni) nucleus *d* 8·0, surrounded by sima of the composition of stony meteorites, *d* 3·0–3·4. The radioactivity of this is only 1/100 of that of the portion outside, and so only sufficient to maintain the temperature uniformly at 1200°. It is enclosed in an isothermal "furnace" of sial maintained at this temperature, *d* 2·8–3·0, which is regarded as consisting of granite floating on pasty basalt magma. On cooling, the granite crust solidified first and subsequently broke up to form a polygonal network, the meshes being more or less circular, similar to the "seas" of the moon, each depression being bordered by a fosse and ridge, and forming the originals of the five oceans. The seas originated through reduction of the metallic oxides of the sial by the $H_2$ of the then atmosphere to form metal and $H_2O$; the absence of $H_2O$ on the moon being due to all $H_2$ having escaped. C. A. S.

**4424. Stability of Magnetic Thermoremanence in Baked Clay and Stones. J. G. Koenigsberger.** *Gerlands Beitr. z. Geophys.* 53. 4. *pp.* 345–351, 1938.—Objects of baked clay, bricks, vessels, and igneous rocks have a residual magnetism, $J_{RC}$, which is acquired while cooling from the Curie points of their contained magnetites in the earth's field. The relation between $J_{RC}$ and the volume susceptibility for fields $< 2$ Oe, the maximum remanence per cm$^3$., and the coercive force all vary with the material and the intensity and duration of baking. The fundamental differences between bricks of different material are brought out by heating. Besides the decrease of residual magnetism produced by heating, there is a spontaneous decrease at ordinary temperatures which is all the more rapid the lower the Curie point and the coercive force; for high values of these, $J_{RC}$ is permanent. In order to obtain reliable conclusions, a study of the magnetisation-temperature curves of the material is advisable.

G. E. A.

**4425. Natural Residual Magnetism of Eruptive Rocks. Part II. J. G. Koenigsberger.** *Terr. Mag.* 43. *pp.* 299–320, *Sept.*, 1938.—Details of the methods of measurement, and the actual results thereof are given for samples of magnetite (both artificial and natural), and of some 50 effusive and intrusive rocks. Some connection appears to exist, in some cases at least, between the results, the age of the rock and the earth's magnetic field in past epochs. [For Part I see Abstract 3168 (1938).] C. A. S.

**4426. Magnetic Properties of Rocks. Part I. Y. Katô.** *Tohoku Univ., Sci. Reports*, 27. *pp.* 91–100, *July*, 1938. *In English.*—The magnetic susceptibility of pumice erupted in 1929 from Mt. Komagatake

(Hokkaido) was investigated. No change was caused by pulverisation. The variation caused by change in temperature showed the magnetism to be due, practically entirely, to the magnetite (3·69%) in the pumice.
C. A. S.

## METEOROLOGY.

**4427. Upper Air Temperature from Dissociation Theory. K. Senda.** *J. Shanghai Sci. Inst. Sect. I.* 1. *pp.* 163–174, *June*, 1938. *In German.*—The temperature of the upper air has been determined by mechanical statistical methods from the dissociation theory in the same way as Saha has used the ionisation theory for the determination of stellar temperatures. For $O_2$ to dissociate almost completely into the atomic state and $N_2$ to be maintained for the most part in the molecular state one must make an assumption of a molecular density of $10^6$–$10^8$ in unit volume in order that the earth's atmosphere at the F-layer, 220 km., shall show a temperature between 1400° and 2000° K. This temperature is somewhat higher than that indicated by other lines but agrees rather well with the general arrangement. R. S. R.

***4428. Katabatic Winds and Prevention of Frost Damage. C. E. Cornford.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 553–585; *Disc.*, 585–587, *Oct.*, 1938.—A new instrument for recording air movements of low velocity and air temperature fluctuations, and a portable anti-radiation screen, suitable for a grass minimum thermometer, are described. Experiments are described showing that certain conditions must be fulfilled in making a just comparison between the air temperature in an orchard-heated plantation and in an unheated plantation. Observations of air currents on hillsides on radiation nights are presented, which show that two winds exist, the "hilltop" wind and the katabatic wind. The effect of each on the other in certain localities is described. It is shown that the hilltop wind is able, on the higher part of a slope facing it, to push uphill the air in the first 10 ft. or so above the ground, and at a lower level to neutralise the force of the katabatic wind, producing a calm belt on the slope. Experiments designed to demonstrate the magnitude of air temperature differences caused by differences in the vegetative cover of the soil alone, by differences in altitude alone, and by a third unknown factor, are described. Evidence is presented showing that when a katabatic wind moves down a slope its temperature does not necessarily decrease. It is indicated how the new information may be applied to the problem of preventing frost damage to crops. Author.

***4429. Equal-Area Transformation of Indicator Diagram and New Aerological Chart. W. Werenskiold.** *Geofysiske Publ.* 12. 6. [10 *pp.*], 1938. *In English.*—On an indicator diagram the work done in a cyclic process can be found directly from the area traced. In some cases the ordinary $p$ $v$ diagram is sufficient, but in aerological work other diagrams may be more convenient. So the condition for equal area transformation of the plane $v$, $p$ upon the plane $x$, $y$ is stated and examined. Certain examples are then considered. Particular relations between $v$, $p$ and $x$, $y$ are now stated and the corresponding chart drawn. The various purposes for which the chart can be used, and the methods of obtaining the results from observed data are indicated with the aid of diagrams. A reproduction of the chart is given. A. E. M. G.

**4430. Diurnal Variation of Atmospheric Condensation-Nuclei. N. E. Bradbury and H. J. Meuron.** *Terr. Mag.* 43. *pp.* 231–240, *Sept.*, 1938.—Records of the diurnal variation of the density of atmospheric

condensation-nuclei have been obtained over a period of four months. The apparatus employed consists of a Wilson cloud-chamber with an expansion ratio of 1·15. At regular intervals the air in the chamber is replaced by a fresh sample, saturated with water-vapour, and subjected to an expansion. A beam of light passing through the chamber is diminished in intensity by the resulting fog, and the degree of extinction may be related to the nuclei-density. The diurnal variation in nuclei-density shows a definite maximum in the forenoon and in the evening with a pronounced minimum prior to sunrise and a midday minimum of lesser extent. Such a variation might be expected in the normal daily convective cycle. The average hourly values of nuclei-density have been compared with the hourly averages of the local component of the diurnal variation of the earth's electric field. The results indicate that in a large measure, if not entirely, the variations in the local component of the earth's potential-gradient arise out of variations in the nuclei-density. AUTHORS.

**4431. Presence of Sodium in the Atmosphere. R. Bernard.** *Zeits. f. Physik*, 110. 5–6. *pp.* 291–302, 1938.—A critical examination of recorded data shows that the yellow line of the night sky, which has an atmospheric origin, has a wave-length of 5892·6 Å. An interferometric investigation at twilight shows that this radiation is produced by Na atoms, probably existing in a thin layer of air about 60 km. high. The line has not been observed in the auroral spectrum. [See Abstracts 3623 and 3625 (1938).] W. R. A.

**4432. Coefficients of Atmospheric Haziness. P. Lejay.** *Comptes Rendus*, 207. *pp.* 439–442, *Aug.* 29, 1938.—The energy arriving at the earth's surface from the sun is examined by a spectrograph [see Abstract 5275 (1937)]. An expression connecting this energy with that arriving at the upper boundary of the atmosphere and the coefficients of absorption for particles of different sizes is given. Methods of determining these coefficients are outlined. A table gives the values of the coefficients determined between Nov., 1936 and March, 1937. Now Ångström has suggested the existence of a preponderating size of diffusing particles in the air. From the observations it appears that these particles exist and that their coefficient of absorption has the form suggested. The author considers that many geophysicists, himself included, still have difficulty in admitting this curious fact. A. E. M. G,

**4433. Path of Ray of Light Tangent to Surface of Earth. J. Sweer.** *J.O.S.A.* 28. *pp.* 327–329, *Sept.*, 1938.—The general equations of the path of a ray of light passing through the terrestrial atmosphere are outlined. The path of the ray tangent to the earth's surface is calculated for the U.S. standard atmosphere. From this is prepared a table of horizon dip, horizon distance, and refraction for altitudes from sea level to 100,000 feet. AUTHOR.

**4434. Processes and Conditions in the Auroral Region. L. Vegard.** *Geofysiske Publ.* 12. 5. [23 *pp.*], 1938. *In German.*—The main problems of spectrum analysis in auroral investigation are examined. New measurements are given relating to the OI, OII and NII lines and the OI triplets and the strengthening of the red OI triplets with increasing heights. Typical intensity distributions and the stimulation of the auroral spectrum are described. The intensity of the first positive group is found to decrease quickly with height. The relation of the two height effects of the A and B types of reddish aurora are described. It is found that red auroræ of the B type occur most frequently at sunspot minima, and thus with

maximum penetration of electric solar rays, as required by the author's theory. Further theory relating to the highest atmospheric layers and the facts on which this is based are described, particularly with regard to the temperature and density and the E- and F-layers, and confirmation of it is obtained. Finally remarks are made on the density distribution at great heights. R. S. R.

**4435. Auroral Phenomena and the Structure of the Ionosphere. L. Vegard.** *Ergeb. d. exakt. Naturwiss.* 17. *pp.* 229–281, 1938.—The investigations and problems of auroral phenomena fall into two main groups. In the first of these we are concerned with the external forms, the geographical distribution and the time variations of the auroræ, also with possible relations between them and other cosmic phenomena such as magnetic disturbances, earth currents and variations of solar activity. The second group includes questions related to the physical phenomena in the highest layers of the atmosphere and in this connection the aurorae themselves are not the only object of investigation, but furnish a powerful means of studying the upper layers of the atmosphere. The present paper gives a comprehensive review of the most important recent publications on the subject. In this the auroral spectrum and its variations play an important part, together with spectral analysis. Tests of the accuracy of the results regarding the upper layers of the atmosphere furnished by auroral investigations, are supplied by allied investigations such as those of the light of the night sky and of radio echoes, both of which have extended the knowledge of the electrical condition of the highest atmospheric layers. A. W.

*See also* Abstracts **4416, 4420, 4441**.

## SEISMOLOGY.

**4436. Travel-Times of Seismic Waves P and S. A. W. Lee.** *Meteorolog. Office, Geophys. Mem.* 9. 76. [16 *pp.*], 1938.—The travel-times of P and S waves are examined, using the data published in the International Seismological Summary of 1930 and 1931 for 146 well-recorded earthquakes; the shocks are all of normal focal depth. The observations of P are in good agreement with the travel-time table published by Jeffreys and Bullen in 1935. For S the observations are generally later than the tabulated times at distances less than 28°, and earlier than the tabulated times beyond 60°. For distances beyond 28° the observations support the amended table given by Jeffreys in 1936. The departures of the S observations from the tables at distances less than 28° are discussed. It is found that there may have been some confusion in the identifications of S up to about 12°, but at the greater distances the discrepancy cannot be explained in that way. Re-examination of the Kew records for a number of earthquakes at distances from 12° to 28° shows that, at least for some shocks, the arrival of S is preceded by a small movement, but this is so inconspicuous that it cannot be mistaken for the large onset generally accepted as S. A new table of travel-times for S has been constructed from the I.S.S. observations of the 146 earthquakes. The interpretation of the observations from the Kew seismograms is improved by the use of this new table. AUTHOR.

**4437. Focal Points of SKS. B. Gutenberg.** *Seismological Soc. of America, Bull.* 28. *pp.* 197–200, *July*, 1938.—The travel-time curve of the first section of SKS depends much on the velocity in the outer part of the core. It begins on the travel-time curve of ScS at an epicentral distance somewhere between 65° and 90°, depending on the velocity of longitudinal waves just below the surface of the core. The extreme values correspond

to velocities there of approximately 8·0 and 7·4 km./sec., respectively. If the distance where SKS begins is relatively large, its first section extends to decreasing distances and is convex towards the axis of distance, and SKS must have an odd number of cusps with focal points (at least one) where it reverses in direction and changes from convex to concave or vice versa. If SKS begins at a relatively short distance, its first segment extends to increasing distances and is concave towards the axis of distance ; in this case the number of cusps is even (possibly zero). In an intermediate case, SKS begins with a focal point. In any case, the first segment of the travel-time curve of SKS is below the travel-time curve of ScS. Similar conclusions are correct for SKKS. A preliminary study of the observations seem to indicate a focal point of SKS at a distance between 70° and 80°. More detailed investigations which are under way may be used to draw conclusions respecting the velocity of longitudinal waves in the outer part of the core. AUTHOR.

**4438. Rayleigh Waves. H. Bateman.** *Nat. Acad. Sci., Proc.* **24**. *pp.* 315–320, *Aug.*, 1938.—With the interaction of air and ground, air waves are generated during an earthquake. The problem investigated mathematically is a type of free vibration of the air and ground, having characteristics of the Rayleigh wave, except that the velocity of propagation is less than that of sound in air instead of slightly less than the velocity of the shear wave in the ground. The effects of variation of wind-velocity and air temperature with height are also considered. The effects and speed of ground roll are discussed and its variation with the depth of the focus. In a further paper (*ibid. pp.* 321–325) various relations of Coulomb's function bearing on Rayleigh waves are treated mathematically. R. S. R.

**4439. Earthquake Sounds. C. Davison.** *Seismological Soc. of America, Bull.* **28**. *pp.* 147–161, *July*, 1938.—The reports of sounds in a large number of earthquakes, mainly British, are analysed. The sounds are usually low-pitched, and almost on the limit of audibility—below it in the case of some observers. They appear frequently to be heard before, more rarely after, the shock, and their maximum to coincide with that of the shock ; the area of audibility is usually rather less than that in which the shock is felt, rarely the reverse. C. A. S.

**4440. Volcanoes, Geysers and Hot Springs. A. L. Day.** *Frank. Inst., J.* **226**. *pp.* 341–352, *Sept.*, 1938.—The composition and physical character of the magma and the participation of steam and other gases in the action are considered. Differences in the action of volcanoes, hot springs, roaring fumaroles, steam jets and geysers in various localities are discussed. These lead to the conclusion that volcanoes and hot springs have a common source of energy, the magma approaching the surface and cooling there, and that the most active agents in volcanic outbreaks and hot springs are the more volatile components of the magma. These seek to escape as they approach the surface and subsequent behaviour is determined by their composition, by the total energy available, the temperature, and the local conditions encountered. R. S. R.

*See also* Abstract 4443.

## TERRESTRIAL ELECTRICITY AND MAGNETISM.

**4441. Electrical Field and Radiation of the Atmosphere. E. Medi.** *Ricerca Scientifica*, **2**. *pp.* 139–147, *Aug.*, 1938.—An account is given of the first results obtained from a comparative study of the

behaviour of the electrical field of the earth and of the radiation of the atmosphere. From a minute analysis considerable analogies are found to occur and raise the question whether there exists a common cause of these phenomena. For the measurement of the electric field the author has used a zero method which he has previously described [see Abstract 1091 (1935)]. The observations can be made accurately and rapidly, as *e.g.*, the record of the change of the electric field owing to the passage overhead of a cloud charged with electricity. Simultaneously with observations of electric field and radiation the temperatures and relative humidity of the air near the apparatus were observed. A suggested explanation of the facts observed is that they are due to the action of solar rays on aqueous vapour with the consequent phenomena of evaporation and condensation. The author concludes that the comparative study of the electrical field and radiation of the earth consists chiefly in the minute analysis of variations of small period. These are important for determining the state of the atmosphere, and for meteorological forecasting. J. J. S.

**4442. Electrical Charge Distribution in Thunderclouds. A. K. Dutta.** *Science and Culture*, 4. *pp.* 67–72, *Aug.*, 1938.—After reference to the normal condition of the earth and the atmosphere, the author discusses the polarity of thunderclouds and methods of investigating the same. A brief *resumé* is given of Simpson's theory regarding the origin of electricity in thunderstorms, which led to negative polarity. Careful experiment indicates, however, positive polarity. The methods of investigation used in determining polarity are indicated. An explanation is offered for the presence of the negative charge on the earth's surface. Some recent experiments by Simpson on the distribution of the electric charges in a thundercloud are described. It is considered that further observation is required before the problem of electric charge distribution can be fully settled. A. E. M. G.

**4443. Changes in Earth's Magnetic Field Accompanying Earthquakes or Volcanic Eruptions. Y. Katô.** *Tôhoku Univ., Sci. Reports*, 27. *pp.* 1–90, *July*, 1938. *In English.*—Numerous examples of changes in the magnetic elements at or near the epicentre of an earthquake or the scene of a volcanic eruption that have coincided with these phenomena are given. This is followed in some cases by a calculation of the equivalent change in a suitably magnetised sphere suitably situated which would produce the same effect. The changes are attributed to movements in magmatic material of differing susceptibility, and more probably to changes in susceptibility due to change in temperature. Whether the changes precede the earthquake or eruption sufficient to give useful warning is discussed. C. A. S.

**4444. Asymmetrical Characteristics of the Earth's Magnetic Disturbance-Field. E. H. Vestine.** *Terr. Mag.* 43. *pp.* 261–282, *Sept.*, 1938.—Asymmetries in the earth's magnetic disturbance-field are considered in relation to the asymmetries in the earth's main field, using data of 32 stations. The auroral-zone curve of terrestrial magnetism, in north polar regions, is elongated in a direction roughly parallel to the elongation of isoclinic curves. It agrees roughly with the the curve of maximum auroral frequency, as given by Fritz, except in regions where his auroral data were scanty. The curve appears to undergo regionally a small diurnal oscillation. The amplitude of the disturbance diurnal variation ($S_D$) is approximately symmetrical with respect to the geographical equator in low latitudes, is zonal-symmetrical with respect to the

auroral zone, and has a zero vertical component near the north pole given by the eccentric dipole. No change in amplitude with longitude has been detected, and it is concluded that induced earth-currents in the oceans contribute little to $S_D$. The local time-phase of the mainly sinusoidal variation $S_D$ shows a range of about 4 hr. with longitude. But if in defining time the geographic north pole be replaced by the north pole given by the eccentric dipole, then at the auroral zone there is no significant variation in time-phase with longitude. This suggests that the auroral zone has a controlling and initiating influence over the world-wide electric currents responsible for $S_D$. Average asymmetries in the geographical distribution of magnetic disturbance and aurora are compared. The average force-vectors for the daily means of disturbance are perpendicular to the average directions of homogeneous auroral arcs, to a high degree of approximation, in polar regions. The $S_D$ electric current-system of magnetic storms proposed by Chapman shows good general agreement with the extensive data here considered. Certain changes are suggested whereby the fit with observation may be improved. AUTHOR.

*See also* Abstracts 4425, 4430, 4477.

## RADIOACTIVITY.

**4445. Theoretical Method in Radioactivity. M. Ferber.** *J. de Physique et le Radium*, 9. *pp.* 337–344, *Aug.*, 1938.—A new method of studying statistical series of the exponential type such as occur in radioactive decay, is outlined. Contrary to the usual procedure, this method uses fractions containing an equal number of intervals. A bidimensional distribution in linear relationship with the distribution $\beta e^{-\beta x}$ is the basis of the method. The distribution is characterised by a unique term, for which an expression is given. The theory is applied to an automatic recording of the $\alpha$-particles from Po. The agreement between theory and experiment is satisfactory. Certain peculiarities in the curves of total frequency and in the observed instants have suggested a possible interpretation which is discussed. G. O. B.

**4446. Radon Condensation Method of Determining Geologic Age. N. B. Keevil.** *Am. J. Sci.* 36. *pp.* 304–309, *Oct.*, 1938.—A modified method of determining the He age is described which overcomes the two criticisms of the two methods previously described. The danger of contamination or removal of Rn during the chemical procedure is eliminated by condensing the Rn directly from the fluxed rock. Another advantage is that all of the determinations can be made on the same specimen, thus lowering the errors due to inhomogeneity. Some preliminary results of Rn determinations and the comparison of the results by three methods on a specimen of the Quincy granite are given. AUTHOR.

**4447. Disintegration Constant of Th and Branching Ratio of Th C. A. F. Kovarik and N. I. Adams, Jr.** *Phys. Rev.* 54. *pp.* 413–421, *Sept.* 15, 1938.—In age determinations of minerals in which Th predominates, some inconsistencies have appeared when the value used for the disintegration constant of Th is that adopted by the International Radium-Standard Commission (1930). This value differs from the

original Geiger-Rutherford value by 30%. The present research was undertaken to determine the disintegration constant of Th by the method of counting $\alpha$-particles. Easily weighed sources were used. The material was obtained from a thorite from the same lot that was used by Geiger and Rutherford. The thorite contained only a small amount of U and correction for the ionium present was made. Various checks on the counting are given. The half-value period of Th was found to be $1{\cdot}39(10)^{10}$ years and the branching ratio, Th C′ to Th (C + C′), is 0·663. A method of impounding the thoron, yet permitting $\alpha$-particles to escape, is described. AUTHORS.

**4448. Decay Constant of $P^{32}$. N. B. Cacciapuoti.** *N. Cimento*, 15. *pp.* 213–219, *April*, 1938.—Using an ionisation chamber and a Perucca electrometer, the half-value of $P^{32}$ is found to be 14·295 days within an error of two parts in 1000. F. C. C.

**4449. Neutron Disintegration of Be and B by Bombardment with $\alpha$-Particles from Po. G. Bernardini.** *N. Cimento*, 15. *pp.* 220–225, *April*, 1938.—It has been shown [see Abstract 2305 (1937) that for several light nuclei resonance levels occur for $\alpha$-particles at about 4 eMV. Using similar apparatus to that previously employed it is found that there is an intermediate level for $C^{12}$ at 2·7 eMV above the ground state. F. C. C.

***4450. Beryllium Isotope of Mass 8. O. Laaff.** *Ann. d. Physik*, 32. 8. *pp.* 743–760, *Aug.*, 1938.—A design of valve amplifier is described suitable for the quantitative measurement of the ionisation effect in an ionisation chamber due to the entry of individual fast particles derived from artificial nuclear disintegration processes; the amplifier is carefully protected from disturbances of electrical, magnetic and mechanical nature. With this amplifier and an ionisation chamber it is demonstrated that the $Be^8$ nucleus disintegrates spontaneously into two $\alpha$-particles which under suitable experimental conditions can be received simultaneously in the ionisation chamber and produce a correspondingly increased impulse. The $Be^8$ is derived from $Be^{11}$ by bombardment of the latter with 185 ekV protons, the process being $Be^{11}(p, \alpha)Be^8$. It is deduced from the dependence of the number of 2 $\alpha$-particle impulses on the aperture of the ionisation chamber that the disintegration energy must be less than 200 ekV. J. E. K.

**4451. Radioactive Mn Isotopes. J. J. Livingood and G. T. Seaborg.** *Phys. Rev.* 54. *pp.* 391–397, *Sept.* 15, 1938.—Five radioactive decay periods of Mn have been obtained by bombarding Co, Fe, Mn, Cr and V with neutrons, deuterons and $\alpha$-particles. Arguments are given for the assignment to various isotopes, as follows:

| Reaction | Half-life | Reaction | Half-life |
|---|---|---|---|
| $Cr^{50}(d,n)Mn^{51}$ | $46 \pm 2$ min. (+) | $Mn^{55}(n,\gamma)Mn^{56}$ | $2{\cdot}59 \pm 0{\cdot}02$ hours (−) |
| $Fe^{54}(d,\alpha)Mn^{52}$ | $21 \pm 2$ min. (+) | $Mn^{55}(d, p)Mn^{56}$ | |
| | $6{\cdot}5 \pm 1$ days (+) | $C^{53}(\alpha,p)Mn^{56}$ | |
| $Fe^{56}(d,\alpha)Mn^{54}$ | | $Fe^{58}(d,\alpha)Mn^{56}$ | |
| $C^{53}(d,n)Mn^{54}$ | $310 \pm 20$ days | $Fe^{56}(n,p)Mn^{56}$ | |
| $V^{51}(\alpha,n)Mn^{54}$ | ($k$ electron capture) | $Co^{59}(n,\alpha)Mn^{56}$ | |

No evidence has been found for radioactive $Mn^{53}$. Chemical identification has been made in all instances, except for the case of the bombardment of V with $\alpha$-particles. The 46-min. period emits positrons with a range

0·9 gm./cm². Al and annihilation radiation absorbed to half-value by 5·0 gm./cm². Pb. The positrons from the 6·5-day activity have a range 0·2 gm./cm². Al. The 310-day activity consists of a soft radiation, whose absorption coefficient is consistent with that of the Cr *Ka* X-ray line, and also a $\gamma$-ray reduced to half-value by 8·4 gm./cm². Pb. The range of the electrons from the 2·6 hour $Mn^{56}$ has been measured as $1·3 \pm 0·1$ gm./cm². Al, while the $\gamma$-ray is brought to half-value by 11·4 gm./cm². Pb. AUTHORS.

**4452. $\gamma$-Rays from F Due to Proton Bombardment. E. J. Bernet, R. G. Herb and D. B. Parkinson.** *Phys. Rev.* 54. *pp.* 398–408, *Sept.* 15, 1938.—A detailed study has been made of the resonance excitation of $\gamma$-rays from F when bombarded with high speed protons in the energy range 0·18 to 2·2 eMV. Because of improvements in the h.v. generator and in the preparation of uniform thin F films, the resonance peaks obtained are much narrower than in the previous work at this laboratory, and many new resonances have been discovered. For the seven resonance peaks which are best defined, estimates are given as to voltage position and half-width. AUTHORS.

**4453. Transmutation of Ti by ThC′ $\alpha$-Particles. W. L. Davidson, Jr. and E. Pollard.** *Phys. Rev.* 54. *pp.* 408–410, *Sept.* 15, 1938.—Protons have been observed from the bombardment of Ti by ThC′ $\alpha$-particles. They are probably due to the reaction $Ti^{48} + He^4 \rightarrow V^{51} + H^1$. Three groups of protons are found corresponding to nuclear energy change $[Q]$ values of $+1·10, 0·00$ and $-3·63$ eMV. The separation of the last two groups is abnormally great. Combined with Dempster's value for the mass of $Ti^{48}$, the results lead to a mass of 50·9598 for $V^{51}$. AUTHORS.

**4454. Transmutation of Sc by ThC′ $\alpha$-Particles. E. Pollard.** *Phys. Rev.* 54. *pp.* 411–412, *Sept.* 15, 1938.—The emission of protons from Sc under bombardment by ThC′ $\alpha$-particles has been observed according to the reaction $Sc^{45} + He^4 \rightarrow Ti^{48} + H^1$. Three groups of protons are found corresponding to nuclear energy changes $-0·3$, $-1·4$ and $-2·6$ eMV. With Dempster's value for the mass of $Ti^{48}$ the mass of $Sc^{45}$ is deduced to be 44·9599. AUTHOR.

**4455. Transmutation of F by Protons and Deuterons. W. E. Burcham and C. L. Smith.** *Roy. Soc., Proc.* 168*A*. *pp.* 176–190, *Oct.* 25, 1938.—The transmutations of F under bombardment with artificially accelerated protons and deuterons have been systematically investigated. The energy of the group of $\alpha$-particles which is emitted during bombardment of F with protons has been accurately determined and leads to a value 19·0043 for the mass of $^{19}F$, in good agreement with the mass spectroscopic value. From the value of the energy release in this process and from the absence of $\alpha$-particle groups of smaller energy it is concluded that the $\gamma$-ray emission from F under proton bombardment arises from successive transitions of excited $^{20}Ne$ nuclei. Five groups of $\alpha$-particles were found to be emitted during bombardment of F with deuterons and the energies of these groups have been determined. From the energy values of these groups it is concluded that excitation levels at 0·83, 2·95, 3·77 and $4·99 \times 10^6$ eV above the ground state exist in $^{17}O$ nuclei. The emission of a group of protons which is believed to be associated with the formation of $^{20}F$ has been observed. From the energy of these protons the value 20·0087 has been deduced for the mass of radioactive $^{20}F$. An energy release of $9·2 \times 10^6$ eV is therefore to be

expected in the radioactive decay process $^{20}F \rightarrow {}^{20}Ne + e^-$ and the disagreement between this value and the observed end point energy of the $\beta$-rays ($5{\cdot}2 \times 10^6$ eV) has been partially reconciled by the observation that a radioactive emission of $\gamma$-radiation accompanies the $\beta$-emission and decays with the same period. AUTHORS.

**4456. Capture of Orbital Electrons by Nuclei. L. W. Alvarez.** *Phys. Rev.* 54. *pp.* 486–497, *Oct.* 1, 1938.—The simple theory of electron capture is outlined and three general methods for its detection are suggested. The first experimental evidence for the process (in activated Ti) is described. A rigorous experimental proof of the hypothesis is given for the case of $Ga^{67}$. A summary of several isotopes whose properties are best explained on this hypothesis is appended. The properties of $Ga^{67}$ are described in considerable detail, and include the first evidence for internal conversion in artificially radioactive atoms. AUTHOR.

**4457. Variational Theory of the $\alpha$-Particle. H. Margenau and W. A. Tyrrell, Jr.** *Phys. Rev.* 54. *pp.* 422–435, *Sept.* 15, 1938.—The energy of the normal state of the $\alpha$-particle is calculated with the use of an elaborate variational method, in which a fixed set of nuclear constants in the general symmetric Hamiltonian has been adopted. The result agrees well with an earlier, independent calculation, and allows the convergence limit to be determined with considerable precision. Comparison with previous work on $H^3$ indicates that the binding energies of both $H^3$ and $He^4$ can be very nearly accounted for with the use of a single set of constants satisfying the conditions imposed by the triplet state of $H^2$; but the value of $g$ (ratio of Heisenberg to Majorana forces) required is lower than usually supposed, and will give somewhat too low an energy for the singlet state of $H^2$. The same methods are employed to calculate the excited singlet and triplet states of the $\alpha$-particle, and yield the results which have already been stated. No excited state is stable. A virtual excited state is shown to exist near the energy of dissociation into four particles. AUTHORS.

**4458. $\beta$-Spectrum of RaE near the Upper Limit and Mass of the Neutrino. A. Alichanian, A. Alichanov and B. Dželepov.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. *pp.* 375–376, 1938. *In English.*—The spectrum of $\beta$-particles from RaE departs from that given by the Uhlenbeck-Konopinsky formula in the upper limits. There is a change in the curve at about 1120 kV, after which the number of electrons decreases nearly linearly. The whole curve fits the Uhlenbeck-Konopinsky theory for $\mu = 0{\cdot}3\ m_0$. [See Abstract 1577 (1938) and following Abstract.] H. G. C.

**4459. $\beta$-Spectrum of ThC near the Limit and Mass of the Neutrino. A. Alichanian and S. Nikitin.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. *pp.* 377–378, 1938. *In English.*—The spectrum of ThC shows a break at 2130 kV after which it falls off nearly linearly. The whole curve is satisfied by $\mu = 0{\cdot}8\ m_0$ in the Konopinsky-Uhlenbeck formula. This and the result for RaE show $\mu$ is not a constant for all elements. [See preceding Abstract.] H. G. C.

**4460. Angles between the Components of a Pair. A. Alichanian, B. Dželepov and P. Spivak.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. *pp.* 379–380, 1938. *In English.*—The pairs from Po, electrolytically deposited on a foil of Al-Be alloy were registered in two Geiger-Müller counters at six different angles. A comparison with the theory of Uhlenbeck and Rose suggests the results agree more closely with

those for quadrupole than dipole transition, but this is not conclusive. A pair created by $\gamma$-rays (Po and Be) in Pb were similarly investigated, but the comparison with theory presents difficulties. H. G. C.

***4461. Pulse Chopper of the Geiger-Müller Counter. M. Kozodaev and G. Latyschev.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 20. 1. *pp.* 21–23, *and pp.* 25–28, 1938. *In English.*—By reducing the resistance in Geiger counter circuits to $10^6$ ohms it is found much easier to obtain a horizontal portion in the usual count-voltage curve. The arrangement suffers from the disadvantage that the counts must be limited to 200–300 per min. if the registration of counts is to be reliable. It is shown how to allow theoretically for lost counts. M. Kozodaev (*ibid.* pp. 25–28) gives further details and properties of the circuit. F. C. C.

*See also* Abstracts 4271, 4273, 4274, 4422, 4482, 4673, 4678, 4685, 4718, 4719.

# RADIATION.

## ABSORPTION.

**4462. Optical Properties of Liquid Suspensions. L. Amy.** *Comptes Rendus*, 207. *pp.* 329–331, *Aug.* 1, 1938.—It has been shown [see Abstract 3518 (1937)] that for a diffusing surface $\alpha/\delta = (1-R)^2/2R$, where $\alpha$ is the coefficient of absorption, $\delta$ of diffusion and R of refraction. It follows that the colour of a suspension is approximately independent of its dilution. This has been checked in many cases. More precisely, the interparticle volume increases slightly more rapidly than the total volume for a constant volume of particles on dilution. Hence $\alpha$ and $\delta$ are not proportional. This is checked experimentally. H. G. C.

**4463. Theory of Absorption in Ionised Gas. Part I. Opacity in Stellar Material. Part II. Optical Properties of Liquid Metals. B. Majumdar.** *Indian Journ. Phys.* 12. *pp.* 233–248, *Aug.*, 1938.—A quantum theory of absorption of electromagnetic radiation by ionised gas is worked out, in which the electrons take up energy from the electric field of the incident radiation and transform it by collisions with ions to random motion of electrons and ions. The theory is applied to calculate the opacity coefficients in stellar interiors and the results are compared with those obtained by Eddington from Kramers' process of absorption for a free-free transition. The optical properties of liquid metals are studied from this general theory and found to agree fairly well with the observations. Author.

**4464. Colour in Relation to Chemical Constitution. I. N. D. Dass and S. Dutt.** *Indian Acad. Sci., Proc.* 8*A*. *pp.* 145–159, *Sept.*, 1938.—Diphenyl-thio-violuric acid has an orange colour in the solid state or in solution in organic solvents, but on treatment with alkalies or organic bases, intense blue and green coloured salts are formed, the transition of colour being sufficiently strong and sharp for the substance to act as an excellent indicator. The change of colour from orange to blue or green has been shown from theoretical considerations to be due to a fundamental change in the constitution of the molecule from an oximino-ketonic to a nitroso-enolic structure. The above change in the molecular structure results in the production of a true nitroso-group, which from the point of view of a

theory of colour on the basis of molecular strain advanced by Dutt, has been shown to be the most highly strained amongst the chromophoric groups, and consequently produces the greatest intensity of colour. The loading effect of the two phenyl groups as well as that of the S atom from the point of view of colour production is discussed, and it is shown that the effect is quite in accordance with the theory. From the study of the absorption spectra of the salts of diphenyl-thio-violuric acid it has been found that their intensity of colour is roughly proportional to the strength of the basic character of the base entering into salt formation. Further study of the absorption spectra of the salts of a series of newly synthesised higher homologues and analogues of diphenyl-thio-violuric acid indicates that the effect of additional load on the molecule of the substance is to produce still further intensification of colour as expected from theoretical considerations, the greatest effect being produced by substituents in *meta*-positions closely followed by those in the *para*. AUTHORS.

*See also* Abstract 4503.

## COLORIMETRY.

**4465. Ideal Colour System. Part II. Reconsideration of the Helmholtz Line Element. R. H. Sinden.** *J.O.S.A.* 28. *pp.* 339–347, *Sept.*, 1938.—The first paper of this series [see Abstract 2537 (1937)] proposed a re-examination of the Helmholtz colorimetric line element, and described a new mechanico-graphical device that has been employed to assist in selecting the coordinate system for which this expression gives best agreement with modern colorimetric data. The coordinate system thus found is fundamentally different from the one determined by Helmholtz himself, and brings about a greatly improved agreement with experimental measurements. In the present paper the new coordinate system is defined, and numerical results afforded by the Helmholtzian function within this frame of reference are compared with observed data and also with the consequences of another theoretical construction. Conclusions are reached concerning the tenability of the assumptions upon which Helmholtz' derivation rests. AUTHOR.

***4466. Simplified and Compact Tricolour Mixing Device. C. N. Warfield.** *Am. Phys. Teacher*, 6. *pp.* 211–213, *Aug.*, 1938.—This lecture-demonstration device utilises colour filters and small wedge-type prisms in front of the focusing lens of an ordinary projection lantern to produce three over-lapping coloured circles on a screen. The relationship between the additive and subtractive primary colours is demonstrated by substituting an opaque circle mounted on clear glass for a circular aperture in the lantern slide holder. AUTHOR.

**4467. Photographic Colorimetry of Dark Surfaces. E. v. Angerer and J. O. Brand.** *Zeits. f. techn. Physik*, 19. 9. *pp.* 254–259, 1938.—A photographic method is described for determining the reflection factor of surfaces as a function of wave-length. The specimen surface and a comparison white surface are illuminated with a source emitting a line spectrum. By a special device the reflected rays from each surface are caused to illuminate only one half the width of the entrance slit of the spectrograph. Thus two slightly displaced line spectra are obtained on the plate. A Hirsch-Schön screen is used to obtain a known variation of intensity along the length of the lines due to the light from the comparison

surface. Thus by noting where the adjacent lines on the photographic plate give equal blackening the reflection factor can be determined.
W. S. S.

## ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

**4468. Electric and Magnetic Birefringence of Liquids. A. Goldet.** *Ann. de Physique*, 10. *pp.* 103–172, *July–Aug.*, 1938.—The thermal variation of the birefringence in electric and magnetic fields of benzene and 20 of its derivatives is examined up to 200° C. Liquid mixtures have been examined near the critical point of miscibility. Certain liquefied gases have been examined at low temperatures. Refractive indices have been examined in a new type of apparatus at high and low temperatures. Contrary to the results of some previous authors, the present measurements show analogy between the various phenomena.
H. G. C.

**4469. Magnetic Rotatory Power of HF. R. de Mallemann and F. Suhner.** *Comptes Rendus*, 207. *pp.* 494–495, *Sept.* 19, 1938.—Direct measurements on an aqueous solution of HF show that the molecular magnetic rotation of HF is very small, as predicted from theoretical considerations. The magnetic rotatory power of the F′ ion has the same order of magnitude as that of the $H^+$ ion.
W. R. A.

## EMISSION.

**4470. Analogy between Photon and Electron and Derivation of Quantum Equation. H. T. Flint.** *Phys. Soc., Proc.* 50. *pp.* 899–909, *Nov.* 1, 1938.—On the view that the theory of the electron is exactly analogous to the theory of the photon, a quantum law is derived which is shown to require the existence of the first-order equation of the quantum theory. The notation required for this purpose is developed, and it is shown to have certain advantages. The limiting character of the fundamental lengths $h/m_0c$ and $e^2/m_0c^2$ follows naturally, and the notation suggests that the latter should be regarded as a limit to the application of present physical theory.
Author.

**4471. Čerenkov Radiation. G. B. Collins and V. G. Reiling.** *Phys. Rev.* 54. *pp.* 499–503, *Oct.* 1, 1938.—Electrons of $2 \times 10^6$ V energy from an electrostatic generator were used to investigate the properties of the asymmetric radiation discovered by Cerenkov [see Abstract 2080 (1937)]. This radiation is produced when electrons traverse a material medium with a velocity greater than the velocity of light in that medium. It was found for several solids and liquids that the direction of the emission of the radiation is accurately expressed by the relation, $\cos\theta = 1/\beta n$, and that the intensity maximum is quite sharp. The nature of the radiation from all solids and liquids investigated was found to be continuous and identical in appearance. The radiation apparently extends with increasing intensity from the infra-red to the u.v. absorption limit of the medium in which it is produced. Rough quantitative measurements of its intensity indicate that one $1{\cdot}9 \times 10^6$ V electron in being brought to rest in water produces 40 quanta in a wave-length range 4000 Å to 6700 Å. These results are in good agreement with the classical explanation of the phenomenon given by Frank and Tamm [see Abstract 2082 (1937)].
Authors.

**4472. Theory of Showers. D. Iwanenko and A. Sokolow.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 681–682, 1938. *In English.*—By using the saddle point method to evaluate an integral, formulæ are obtained for the number of particles and the number of photons in the theory of showers. G. O. B.

**4473. Nature of Primary Cosmic Radiation. T. H. Johnson.** *Phys. Rev.* 54. *pp.* 385–387, *Sept.* 1, 1938.—The author supposes the existence of some unspecified process within the atmospheres of stars in which either electrons or positive ions are given an original impulse. As these pass outwards through the stellar atmosphere secondary positive and negative electron pairs and an equilibrium intensity of photons are generated. It is shown how, with the aid of the assumption of a galactic magnetic field, the radiation reaching the earth is reduced to a mixture of positive and negative electrons in equal numbers, constituting the soft component of the cosmic radiation, and a group of heavy positive particles whose penetrating secondaries produce most of the intensity at sea-level and below and account for the east-west asymmetry. The mechanism suggested avoids the building up of enormous potential differences between relatively close points in inter-stellar space. D. H. F.

**4474. Theory of Cosmic-Ray Phenomena. H. Euler and W. Heisenberg.** *Ergeb. d. exakt. Naturwiss.* 17. *pp.* 1–69, 1938.—The main phenomena of cosmic radiation are reviewed theoretically from the point of view of the adequacy of quantum mechanics to cover them, even to the highest energies. The paper divides into five parts: (*a*) general review of the properties of single particles, (*b*) theory of the light particles (electrons and positrons), (*c*) theory of the heavy particles (heavy electrons, protons and neutrons), (*d*) energy spectrum of the radiation and its absorption, (*e*) discussion of the secondary effects (*e.g.*, showers). A Bibliography is appended. D. H. F.

**4475. Absorption of Cosmic Rays in Water to Depth of 440 m. J. Clay, A. v. Gemert and P. H. Clay.** *K. Akad. Amsterdam, Proc.* 41. 7. *pp.* 694–705, 1938.—Measurements of cosmic-ray intensity were made with an ionisation chamber, and with coincidence-counting assemblies for which the selected cone of rays had various values, with and without Pb screens between the counters. Definite, though sometimes small, differences were found between the intensity-depth curves under the different conditions. It is concluded that at a depth of 200 m. the proportion of soft rays begins to increase, the proportion being greatest between 280 and 400 m. Comparison with results obtained in a mine shows that the decrease in intensity is proportional to the density of the absorbing medium. Below 50 m. the results can be represented by $I = I_0/h^2$ and hence an expression for the energy distribution of the rays is calculated. D. H. F.

**4476. Zenith-Angle Intensity Distribution of Cosmic Rays. J. Clay, J. T. Wiersma and K. H. J. Jonker.** *K. Akad. Amsterdam, Proc.* 41. 7. *pp.* 706–708, 1938.—The zenith-angle distribution was measured with counters in the E.–W. and N.–S. directions, at a magnetic latitude of 50°, and in both cases the intensity is found to be approximately proportional to $\cos^2 \alpha$ ($\alpha$ = zenith angle). With 30 cm. Pb between the counters higher values relative to the vertical intensity are found, but it is calculated that if the Pb had been placed as a horizontal layer over the counters the $\cos^2 \alpha$ distribution would have been obtained. It is concluded that the decrease of the number of particles is inversely proportional to

the square of the thickness of material traversed ; the coefficient of decrease of oblique rays is smaller than that of vertical rays. D. H. F.

**4477. Cosmic-Ray Effects Associated with Magnetic Storms. S. E. Forbush.** *Terr. Mag.* 43. *pp.* 203–218, *Sept.*, 1938.—Evidence indicates that the storm-time field of some magnetic storms causes world-wide changes of several per cent in cosmic-ray intensity. That other magnetic storms of equal intensity at the earth's surface occur with no appreciable cosmic-ray effects definitely indicates that the entire current-system for the storm-time field of both types of storms cannot be located at the same distance above the earth. In particular, the possibility that the current-systems responsible for the two types of storms both lie within the earth's atmosphere appears remote. Assuming the current-system for the storm-time field of both types of storms to consist of a ring concentric with the earth in the geomagnetic equatorial plane, magnetic data are analysed to determine whether the radius of the assumed ring is, as would be expected, greater for magnetic storms, which affect cosmic-ray intensity. Although the analysis is not conclusive on this point, the results satisfy a necessary condition for the existence of such a ring-current. The occurrence of aurora in temperate latitudes during most of the magnetic storms which affected cosmic-ray intensity is interpreted, after Störmer, to indicate the existence of such ring-currents. The percentage-changes in cosmic-ray intensity during magnetic storms is within the observational uncertainty the same at geomagnetic latitudes 50°·1 N. and 0°·6 S. The significant correlation between changes in daily means of cosmic-ray intensity, for two stations separated 50° in latitude, probably results from the same mechanism responsible for the magnetic-storm effect. AUTHOR.

**4478. Bursts in Cosmic Radiation in the Equatorial Zone. S. A. Korff.** *Terr. Mag.* 43. *pp.* 227–230, *Sept.*, 1938.—Bursts in cosmic radiation observed in Peru and in northern latitudes are compared. It is found that the bursts have the same distribution in energy both at high altitudes in the equatorial zone and at sea-level in northern latitudes. The number of bursts is found to vary approximately as the third power of the number of ions in the burst. The number of bursts increases with altitude approximately as the square of the total ionisation measured in the same instrument. Bursts are found to produce about one part in 1000 of the ionisation observed in the instrument. AUTHOR.

**4479. Multiplicative Production of Hoffmann Bursts. H. Euler.** *Zeits. f. Physik*, 110. 7–8. *pp.* 450–472, 1938.—Two classes of Hoffmann bursts are distinguished ; this paper deals with those resulting from multiplicative cascade processes. It is shown that the quantitative characteristics of the bursts, especially in relation to the variation with height above sea-level, are consistent with the assumption that they are due to electrons, falling into two distinct classes : (i) secondary to the penetrating component, comprising most of the electrons at sea-level, varying little with height and responsible for most of the bursts below about 1000 particles ; (ii) secondary to the extra-terrestrial electron component of the primary radiation, decreasing rapidly with increasing depth in the atmosphere, comparable in intensity at sea-level with class (i) only at the highest energies, and responsible for the bursts of more than about 1000 particles. An energy distribution for the electrons in this group is calculated. In an Appendix an expression for the fluctuations of the sizes of the bursts is derived. D. H. F.

**4480. Hard Cosmic-Ray Showers. K. Schmeiser.** *Zeits. f. Physik*, 110. 7–8. *pp.* 443–449, 1938.—It is found that the absorption-curves of the hard showers reported previously [see Abstract 2423 (1938)] are independent of the nature of the material in which they originate, and that their absorption by different materials is mass-proportional. It is confirmed that the intensity of the showers is approximately proportional to the atomic number of the shower-producing material. Experiments were performed to show that the so-called *Zusatzstrahlung* which, according to Zeiller [see Abstract 4226 (1935)] is liable to vitiate absorption measurements, actually consists of soft showers secondary to the hard showers. D. H. F.

**4481. Absorption of Shower-Producing Component of Cosmic Radiation in Iron and Lead. J. Crudup.** *Phys. Rev.* 54. *pp.* 483–486, *Oct.* 1, 1938.—Measurements of the absorption coefficient of the shower-producing component of primary cosmic radiation give $0{\cdot}35$ cm$^{-1}$. in lead and $0{\cdot}076$ cm$^{-1}$. in iron. The atomic absorption coefficients corresponding to these values are nearly in direct proportion to the squares of the atomic numbers of the absorbing materials. The value $0{\cdot}35$ cm$^{-1}$. for lead agrees rather well with that found by Woodward. A slight minimum was found in the curve of the absorption for lead at a point between 8 and 10 cm., confirming similar findings by Rossi and others. No minimum was found in the absorption curve for iron up to a thickness of 20 cm. For the rays received within a given solid angle, the ratio of the shower rate to the vertical coincidence rate falls from $5{\cdot}1\%$ with no shield to $2{\cdot}6\%$ with 15 cm. of lead, and to $3{\cdot}0\%$ with 20 cm. of iron. Author.

**4482. Report on the Work of the Bartol Research Foundation, 1937-1938. W. F. G. Swann.** *Frank. Inst., J.* 226. *pp.* 441–503, *Oct.*, 1938.

*See also* Abstracts 4458, 4459, 4515, 4561, 4674.

## FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

**4483. Nitrogen Afterglows. D. B. McNeill and K. F. Harvey.** *Phil. Mag.* 26. *pp.* 502–506, *Oct.*, 1938.—In a previous paper [see Abstract 1605 (1938)] some phenomena connected with active nitrogen and nitrogen afterglows were described. In this an account was given of the action of impurities in the discharge and a hypothesis was advanced to explain the production of the intercombination (Vegard-Kaplan) bands. These bands have not yet been produced with the intensity required for their rotational structure to be analysed. In the present paper, some attempts to develop strong sources of the bands are described. These failed in their original purpose, but other observations were made, which are described together with experiments on the diffusion of the Lewis-Rayleigh form of the afterglow and its behaviour in a magnetic field. Authors.

## INTERFERENCE, DIFFRACTION AND SCATTERING.

**4484. Diffraction of Converging Light Waves. I. Fränz-Gotthold and M. v. Laue.** *Ann. d. Physik*, 33. 3. *pp.* 249–258, *Oct.*, 1938.—The diffraction arrangement described by Lau [see Abstract 3569 (1937)], in which the diffraction pattern in the focal plane of a lens is made sharper by the introduction of an opaque screen into the edge of the converging light beam, is now treated mathematically. C. B. A.

*See also* Abstracts 4562, 4610, 4611, 4661.

## PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

**4485. Photochemistry.** *J. Phys. Chem.* 42. *pp.* 699–854, *June*, 1938.—The third report of the Committee on Photochemistry, National Research Council, consisting of an Introduction by **H. S. Taylor** (*pp.* 699–700) and the following 11 papers.

"Experimental Technique in Photochemistry," by **F. Daniels** (*pp.* 701–711).—Records advances in technique dealing with light sources, production of monochromatic light, measurement of radiation, reaction cells, chemical analysis, high and low temperatures, and absorption spectra.

"Table of Quantum Yields in Experimental Photochemistry," by **F. Daniels** (*pp.* 713–732).

"Nature of the Primary Process in Photochemical Reactions," by **G. K. Rollefson** (*pp.* 733–737).—Summarises the more recent aspects of the primary absorption process.

"Comparisons between Photochemical Processes in Gases and Solutions," by **R. G. Dickinson** (*pp.* 739–748).

"Mechanism of Aldehyde and Ketone Photolysis," by **P. A. Leighton** (*pp.* 749–761).—Discusses absorption spectra, primary process in decomposition, secondary reactions in decomposition.

"Hydrocarbon Free Radicals in Photochemical Processes," by **H. S. Taylor** (*pp.* 763–772).—Deals with the reactions in alkyl iodides, metal alkyls, mercury-photosensitised hydrogenations and decompositions of hydrocarbons, and the photolysis of azo-compounds.

"Evaluation of Specific Reaction Rates in Chain Reactions," by **G. K. Rollefson** (*pp.* 773–781).—Considers the three main types of processes: (1) chain starting, (2) chain terminating, and (3) chain continuing.

"Secondary Processes in the Photodecomposition of $NH_3$ and $N_2H_4$," by **H. S. Taylor** (*pp.* 783–788).

"Secondary Processes in the Photochlorination of CO and $H_2$" by **H. S. Taylor** (*pp* 789-794).

"Action of Optical Sensitisers on the Photographic Plate," by **G. Kornfeld** (*pp.* 795–813).—Surveys the published work dealing with the mechanism of optical sensitising of photographic emulsions, the connection between sensitising and other properties, and the mechanism of desensitising.

"Photosynthesis," by **W. M. Manning** (*pp.* 815–854).—The following sections are discussed: Measurement of photosynthesis, general description of the photosynthetic process, and the rôle of chlorophyll in the photosynthetic process. R. C. F.

**4486. Photochemical Researches in the Extreme Ultra-Violet. Part VI. W. Groth and P. Harteck.** *Zeits. f. Elektrochem.* 44. *pp.* 621–627, *Sept.*, 1938.—Deals with the mechanism of the $H_2$–$O_2$ reaction from a consideration of the thermal $H_2$–$O_3$ reaction. O atoms are produced by the action of the Xe resonance lines 1470 Å and 1295 Å on a flowing mixture of $H_2$ and $O_2$ at atmospheric pressure with an $O_2$ partial pressure of from 0·3% to 8%. The reaction products due to the action of these O atoms on the mixture are measured and compared with the $O_2$ partial pressure, conclusions thereby being drawn regarding the secondary processes. [See also Abstract 5305 (1937) and following Abstract]. R. C. F.

**4487. Photochemical Researches in the Extreme Ultra-Violet. Part VII. K. Faltings, W. Groth, and P. Harteck.** *Zeits. f. phys.*

*Chem.* 41. *Abt.B.* 1. *pp.* 15–22, 1938.—The absorption and photochemical decomposition of CO when irradiated with the resonance lines of Xe at 1295 and 1470 Å have been investigated. Only the shorter wave-length light causes decomposition with a quantum efficiency of 1. $CO_2$ and $C_3O_2$ are formed. The dissociation energy of the CO molecule has been obtained from the photo-decomposition. The value obtained lies between 219 and 193 kg.-cal. The photochemical reactions occurring when a mixture of $H_2$ and CO is irradiated with the resonance lines of Xe have also been investigated. HCHO, $H_2O$, and $H_2O_2$ are formed. The mechanism of the formation of the last two is considered, and it is supposed that this occurs through the intermediate production of HCO radicals. [See also preceding Abstract.] A. J. M.

**4488. Photodecomposition of Ethyl Methyl Ketone by Wave-Lengths from 1850-2000 Å. V. R. Ells and W. A. Noyes, Jr.** *Am. Chem. Soc., J.* 60. *pp.* 2031–2036, *Sept.*, 1938.—Photodecomposition of ethyl methyl ketone in the near u.v. (largely with the 3130 Å line of Hg) leads to the production of diketones, approximately 11% of the reaction going in this way at room-temperature. The quantum yield of CO formation from ethyl methyl ketone at room-temperature with wave-lengths from 1850 to 2000 Å increases from about 0·70 to about 0·88 as the pressure decreases from 90 mm. to 0·1 mm. Diketones are formed in this region of the spectrum. The formation of biacetyl has been shown spectroscopically. The total quantum yield of ethyl methyl ketone decomposition with wave-lengths below 2000 Å is nearly one at low pressures when allowance is made for diketone formation. At higher temperatures some $CH_4$ is formed, but at room-temperature the principal hydrocarbons are ethane, propane and butane in approximately equal amounts. Possible secondary reactions are discussed. AUTHORS.

**4489. Photography. C. E. K. Mees.** *Frank. Inst., J.* 226. *pp.* 281–292, *Sept.*, 1938.—Summarises recent theoretical work and gives details of some practical developments. A. H.

***4490. Stability of Viscose Type of Ozaphane Photographic Film. A. M. Sookne and C. G. Weber.** *Bureau of Standards, J. of Research*, 21. *pp.* 347–353, *Sept.*, 1938.—Viscose Ozaphane, a new type of film with a base of regenerated cellulose sheeting, and having certain advantages for record use, was tested to determine its comparative stability. Its stability was compared with that of cellulose nitrate, and also with that of cellulose acetate, which is widely used for film-slides, and which has been found to be a very stable material for preserving records in libraries. The viscose type of film apparently is not suitable for permanent records, but does appear to have properties to recommend its use for reading-room copies that can be replaced when they become unserviceable. The stability was determined by measuring changes in its chemical and physical properties under accelerated ageing. The changes observed were increase in acidity and copper number, and decrease in viscosity, weight, and flexibility. AUTHORS.

**4491. Foreign Nuclei in AgBr. Lüppo-Cramer.** *Kolloid Zeits.* 84. *pp.* 340–344, *Sept.*, 1938.—The " Capri Blue " effect discovered by the author, *viz.*, the curve alterations of germless large-grained emulsions of slight sensitivity produced by certain dyestuffs, may be explained by the formation of nuclei other than those of Ag and $Ag_2S$ which increase the sensitivity of the AgBr. The conditions are discussed, which must already be present in the emulsions, for the dyestuffs to play a similar

rôle to that of the Ag-containing nuclei in ordinary emulsions or by other foreign substances in other light-sensitive systems. H. H. Ho.

**4492. Photographic Sensitivity and the Reciprocity Law at Low Temperatures. W. F. Berg and K. Mendelssohn.** *Roy. Soc., Proc.* 168*A*. *pp.* 168–175, *Oct.* 25, 1938.—Photographic materials show an appreciable sensitivity down to 20° K. Little change occurs when the temperature is dropped from 90° K. to 20° K. The main difference is a drop in contrast and in maximum density. No reciprocity failure occurs at temperatures of 90° K. and 20° K. It is suggested that at these temperatures the latent image is formed in two distinct stages: (*a*) an electronic process, in which the electrons are separated from the Br ions absorbing the light, and freeze into the lattice, and (*b*) an ionic process, taking place on warming up, consisting of a movement of the Ag and probably also the Br atoms. Authors.

**4493. Reflex Copying. L. van der Grinten.** *Phot. J.* 78. *pp.* 579–583 *and* 586, *Sept.*, 1938.—The various methods that have been used for reflex copying are described and their respective advantages and disadvantages pointed out. The Retocee process of screen reflectography is also discussed. A. H.

***4494. Physical Density Comparator. M. H. Sweet.** *J.O.S.A.* 28. *pp.* 349–353, *Sept.*, 1938.—A density comparator is constructed using filtered tungsten radiation and Polaroid plates as a means for obtaining an accurate standard of comparison. In order to measure the densities of small areas of the negatives and print, high flux concentrations are used. The infra-red is filtered from the total radiation by submerging the incandescent source in a tank of water. A water-air lens is used to condense the light. The instrument permits the measurement of both transmission and reflection densities. Author.

*See also* Abstracts **4466**, **4498**, **4561**.

## PHOTOMETRY.

***4495. Apparatus for Testing Highway Sign Reflector Units. R. Kingslake.** *J.O.S.A.* 28. *pp.* 323–326, *Sept.*, 1938.—Describes apparatus which gives a measure of the flux reflected within a specified small cone from a reflector button when illuminated by a headlight. A rectifier photo-cell has a small hole drilled in it; the image of a projector lamp filament is formed on this hole which is of a size which represents an automobile headlight on the same scale as the distance of the button from the cell represents 62 ft. The light from the hole is collimated by a lens and falls on the button either normally or at any desired degree of tilt. The reflected light falls on the collimator and thence reaches the photo-cell. A mask in front of the cell delimits the beam to an angle of divergence of 1°. The cell is calibrated and, from the current given, the total flux reflected within the cone is measured. The author points out that the results cannot be expected to correlate well with the ordinary visual test since the latter depends on candle-power and not flux. J. W. T. W.

*See also* Abstracts **4561**, **4564**, **4567**.

## POLARISATION.

**4496. State of Polarisation of the Wave Penetrating into the Second Medium in Total Internal Reflection. S. Gandolfo.** *N. Cimento*, 15. *pp.* 139–144, *March*, 1938.—With plane polarised incident

light the totally internally reflected beam is in general elliptically polarised. The connection between the ellipticities of the reflected beam and the beam penetrating into the second medium is worked out on the usual theory. Experimental test is promised. W. S. S.

**4497. Spectropolarimetry. J. Rabinovitch.** *Rev. d'Optique*, 17. *pp.* 161–163, *April*, 1938.—A description is given of the method put forward originally by Fizeau and Foucault for the rapid determination of the variation of rotatory power with wave-length, where the use of a prism in conjunction with originally crossed nicols between which the optically active material is placed produced a black band in the spectrum—the rotation of the substance for a given wave-length being given by the angle through which the analyser has to be turned to bring the band to that point in the spectrum. The rapidity of the method for survey purposes is stressed and its usefulness in cases where the rotatory dispersion curve is anomalous is also indicated. A. H.

**4498. Theory of Photodichroïsm. S. Nikitine.** *Comptes Rendus*, 207. *pp.* 331–333, *Aug.* 1, 1938.—The theory of photodichroïsm previously developed [see Abstract 2875 (1938)] is generalised by means of the hypotheses of Jablonski. The theory has been compared with the experimental results. H. G. C.

***4499. Senarmont Compensator. F. Gabler and P. Sokob.** *Zeits. f. Instrumentenk.* 58. *pp.* 301–316, *Aug.*, 1938.—The authors discuss the theory, design and adjustment of the Senarmont compensator for determining the ellipticity of polarised light. As analyser, a simple nicol and half-shade arrangements of the Schönrock and Chauvin types are considered. The precision of setting with the half-shade arrangements is calculated, allowing for the change of contrast sensitivity of the eye with brightness. W. S. S.

***4500. Measurement of Elliptically Polarised Light with the Calderon Double Plate. G. Szivessy and W. Herzog.** *Zeits. f. Instrumentenk.* 58. *pp.* 345–355, *Sept.*, 1938.—Continuing previous work on the use of a double plate for the detection of elliptically polarised light [see Abstract 3234 (1938)], the authors show how the azimuth, ellipticity and sense of rotation can be measured with the Calderon double plate. The design of the double plate to give optimum sensitivity is discussed. W. S. S.

*See also* Abstracts **4563**, **4693**.

## REFLECTION, REFRACTION AND DISPERSION.

***4501. Optics of Head-Lights. J. H. Nelson.** *Journ. Sci. Instruments*, 15. *pp.* 317–322, *Oct.*, 1938.—Briefly deals with the conditions to be fulfilled when designing a lamp, the optical principles of modern mass-produced head-lamps, anti-dazzle lamps and fog lamps. R. C. F.

**4502. Reflection and Transmission Coefficients of Very Thin Metallic Layers. P. Rouard.** *Rev. d'Optique*, 17. *pp.* 1–10, *Jan.*; 61–69, *Feb., and pp.* 89–112, *March*, 1938.—The method is described by which the coefficients of reflection, (I), and transmission, (II), of very thin layers of the noble metals, deposited on supports of glass or quartz, have been determined. For the metals studied and for all wave-lengths, when the light is reflected in the transparent support, (I) passes through a definite minimum as the thickness of the layer grows from 0 to 10 $m\mu$. The nature of the support, the different methods of preparation, and the ageing of the layers influence the results obtained for (I) and (II), and

account for the different recorded values. Comparison of experimental results with those predicted by a theory, which is developed, indicates optical constants in thin layers different from those of the metals in bulk. For Ag the divergence of these values is notable when the ratio of the thickness of the layer to the wave-length is less than 0·04. [See Abstract 2441 (1938).] W. R. A.

**4503. Gas Absorption and Optical Constants of Thin Metal Foils. M. Kindinger and K. Koller.** *Zeits. f. Physik*, 110. 3–4. *pp.* 237–250, 1938.—Thin metal foil is assumed to absorb considerable amounts of gas ; the number of free electrons in the metal is much increased due to ionisation of the gas atoms ; the thickness of very thin metal foil, determined by weighing, may be in error by more than 100% owing to gas absorption. The effect of gas absorption upon the optical constants of metal foil is discussed theoretically and it is shown that it is considerable for long wave-lengths and vanishes in the u.v. ; it is negligible for both thick and extremely thin films and is appreciable only for films of thickness 5 to 30 $m\mu$. Discrepancies in values of the optical constants of thin films determined by various observers are attributable in part to errors in the thickness of films as determined by weighing and in part to changes in the optical constants due to gas absorption. The correctness of these conclusions is established experimentally by results relating to the transparency of gold films of thickness up to about 100 $m\mu$ for radiation of wave-length 436 $m\mu$. J. S. G. T.

**4504. Optical Constants of Very Thin Metal Films. K. Försterling.** *Ann. d. Physik*, 33. 2. *p.* 132, *Sept.*, 1938.—Correction to the original [see Abstract 1169 (1938)].

**4505. Abnormal Birefringence in a Compressed Transparent Substance. A. Cotton, G. Courtot and J. Guillemin.** *Comptes Rendus*, 207. *pp.* 313–316, *Aug.* 1, 1938.—" Plexiglas " is transparent, has an index of refraction 1·49 and density 1·18. If it is subjected to pressure it shows, similarly to glass, immediate negative birefringence. The magnitude of it decreases with the time to a constant value and on removing the pressure a positive birefringence remains equal to the difference between the two values under pressure. This gradually dies away. H. G. C.

**4506. Refractive Dispersion of Oils and Fats. Part I. V. T. Athavale and S. K. K. Jatkar.** *Indian Inst. of Science, J.* 21*A*. 3. *pp.* 15–25, 1938.—The refractive dispersions of butterfats from different sources have been measured on a Pulfrich refractometer and the dispersion constants are found to be sufficiently different from those of vegetable oils to account for the characteristic colour fringes on a simple type of butyro-refractometer. It should be possible to detect adulteration of ghee by measurement of both refractive index and dispersion on a Pulfrich refractometer using the green and violet lines of the Hg arc. Mixtures of oils can be prepared to give the same refractive index as that of ghee, but it will be difficult to get the same dispersion, especially in view of the fact that oils of lower refractive index and consequently lower dispersion are usually employed for adulteration. AUTHORS.

**4507. Dispersion Theory. C. Schaefer.** *Ann. d. Physik*, 33. 3. *pp.* 243–248, *Oct.*, 1938.—It is shown that a result, identical in form and significance with that derived from the wave-mechanical treatment, can

be obtained from classical theory if account is taken of the inter-relationship between the " characteristic frequencies ", as, for instance, in a series. C. B. A.

***4508. Luminosity of Telescope Images. V. Ronchi.** *Zeits. f. Instrumentenk.* 58. *pp.* 316–321, *Aug.*, 1938.—The author summarises a number of investigations dealing with the luminosity of telescope images in relation to the sizes of the exit and entrance pupils and the magnification of the telescope. The results are not in accord with the usual theory and indicate that certain special properties of the eye are operative. W. S. S.

***4509. Position of the Exit Pupil of Telescopes. C. v. Hofe.** *Zeits. f. Instrumentenk.* 58. *pp.* 374–377, *Sept.*, 1938.—The position of the exit pupil of a telescope with respect to the observer's eye pupil affects the value of the instrument in use. The author derives an expression for the distance of the exit pupil from the eye-piece for a telescope employing two reversing lenses with condensing lenses in the two image planes. It is shown how with such a system the exit pupil may be placed in any desired position. W. S. S.

*See also* Abstracts 4305, 4332, 4334, 4366, 4433, 4462, 4467, 4495, 4569, 4580, 4648.

## SPECTROSCOPY.

**4510. Luminous Effect for the Detection of Sulphur Compounds. E. Schröer.** *Zeits. f. phys. Chem.* 40. *Abt.B.* 6. *pp.* 450–454, 1938.—An account is given of a sensitive method for the detection of S by the emission of blue light from a $H_2$ flame into which the S compound is introduced. Experimental evidence is adduced in support of the explanation that this emission is due to $S_2$ molecules excited by the recombination of H atoms. The energy of excitation of $S_2$ coincides with the heat of recombination of H + H. L. A. W.

**4511. Excitation of Balmer and Paschen Series of H and D by Electrodeless Discharge. H. Nagaoka and T. Mishima.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 815. *pp.* 931–956, *Sept.*, 1938. *In English.*—Balmer and Paschen series were excited in a tube 15 cm. wide and 100 cm. long containing $H_2$ or $D_2$ by electrodeless discharge, using a 30 kW transformer and 0·003 $\mu$F condenser with exciting coil. A spark gap for continuous discharge with compressed air gap maintained the discharge without interruption. Sparks were examined by photographing them on a rapidly rotating film. Spectra were studied with a Steinheil GH spectrograph. Balmer series for H and D, almost free from secondary spectrum, were obtained, by proper adjustment of pressure and focusing, to $n$ 25; with slightly increased pressure to $n$ 37, but mixed with secondary spectrum as given by photometric curve. The electron distribution function for $n$ 10 is diagrammatically shown, to illustrate the complexity of electron distribution. $\lambda_H$—$\lambda_D$ from $n$ 7 to 20 are given. Paschen series for H and D to high terms are described, and compared with Merrill-Wilson spectrograms of hot stars in infra-red. Accurate measurement of $\lambda_H$—$\lambda_D$ for Balmer and especially Paschen series is emphasised. AUTHORS.

**4512. Effect of Current Strength on Line Broadening in High Pressure Hg Discharge. R. Rompe and P. Schulz.** *Zeits. f. Physik*, 110. 3–4. *pp.* 223–232, 1938.—The effect of current strength on broadening of lines 5770Å ($2^1P_1-3^3D_2$) and 10140Å ($2^1P_1-2^1S_0$) is examined; the former has a much greater temperature effect than the latter but in each case the relationship is linear. The broadening of

the 5770Å line is due to electron impact whilst that of the 10140Å line is due to *Eigendruck* broadening. [See also Abstract 2458 (1938).]

H. J. H. S.

**4513. Light Intensity Distribution in High Pressure Hg Arc Discharge. F. Rössler.** *Zeits. f. Physik*, 110. 5–6. *pp.* 352–359, 1938.—The light intensity of the more important lines in the high pressure Hg arc discharge is measured as a function of the distance from the axis of the discharge. The curves are similar and show a maximum on the axis. The continuous spectrum in the region of 3240 Å gives a similar distribution but shows an appreciable increase in intensity near the edges of the discharge and, in addition, the distribution is affected by current strength. An explanation of the results is attempted. H. J. H. S.

**4514. Visible and U.V. Radiation of High-Pressure Hg Discharge. J. Kern.** *Zeits. f. techn. Physik*, 19. 9. *pp.* 249–254, 1938.—Measurements were made of the light yield (lumen/W) and the radiation yield in the medium and long-wave u.v. for different pressures, energy consumptions and tube diameters. The light yield and radiation yield both increase with consumption (W/length of arc). Increase of pressure raises the light yield but not the radiation yield. Increase in tube dia. also raises the light yield but reduces the radiation yield. An empirical formula is derived to represent the results. W. S. S.

***4515. Improvements in Fused-Quartz Mercury Arcs. L. B. Johnson and S. B. Webster.** *Rev. Sci. Instruments*, 9. *pp.* 325–327, *Oct.*, 1938.—Five new a.c. Hg arcs between oxide-coated tungsten electrodes in fused-quartz are described and the spectral intensity of each lamp is tabulated. Several points of superiority over the familiar Hg-pool kathode types are discussed. Authors.

**4516. Pressure Broadening in the Wings of the Mercury Resonance Line 2537 Å. H. A. Rühmkorf.** *Ann. d. Physik*, 33. 1. *pp.* 21–51, *Aug.*, 1938.—The broadening of the Hg-resonance line 2537 Å has been investigated for high pressure of the Hg vapour and under addition of $N_2$, $O_2$ and $CO_2$ at pressures from 1–6 atm. and of A at 1 atm. pressure. In all cases the absorption coefficient was proportional to the number of absorbing Hg atoms and to the number of disturbing particles. It follows that the broadening is produced by interaction of one Hg atom with one disturbing particle only. The comparison of the experimental results with theoretical considerations shows that the broadening of the line near the centre is caused by collisions with particles of high velocities while farther away from the centre the broadening is determined by the interaction with particles at rest. A broadening in consequence of the coupling of equal atoms (Hg–Hg interaction) can only occur in the immediate neighbourhood of the centre of the line and is therefore only of minor importance. On the high frequency side of the line occur diffuse bands whose positions depend on the nature of the disturbing gas. Their wavelengths are given. The van der Waals constants are determined from the region where the absorption coefficient is proportional to $(\nu_0-\nu)^{-3/2}$, and the optical cross-sections are calculated which show a reasonable agreement with the cross-sections computed from the broadening by collisions. L. K.

**4517. Electron Temperature and Light Excitation in Gas Discharge Excited by Short and Ultra-Short Waves. W. Nöller.** *Zeits. f. Physik*, 110. 5–6. *pp.* 320–329, 1938.—The intensity relation between the He lines 4121 and 4144 Å is calculated for given conditions

of pressure, disposition of electrodes and exciting potential. The results are then compared with experiment for pressures of 0·8 and 6·0 mm. Hg and for excitation frequencies of $4 \times 10^6$ and $10^9$ and good agreement is found. It is pointed out that the usual discrepancy between the values of electron velocity calculated from electrical data and those deduced by the optical method is due to neglecting the electron velocity distribution in the latter method. H. J. H. S.

**4518. Energy Distribution in a Spectrum Consisting of Lines and Continuum. F. Rössler.** *Zeits. f. Physik.* 110. 7–8. *pp.* 495–501, 1938.—The absolute intensities both of the lines and of the continuous background can be obtained by working with a spectrograph (or monochromator) of variable slit width. R. P.

**4519. Effective Cross-Section for Collisions of the Second Kind in Excited Hg Vapour and Hyperfine Structure of Hg Resonance Line 2537 Å. O. Buhl.** *Zeits. f. Physik,* 110. 5–6. *pp.* 395–396, 1938.—It has been pointed out to the author that the formula due to Inglis, which he applied to the determination of the h.f.s. of Hg in a previous paper [see Abstract 3247 (1938)] and which led to the conclusion that $Hg^{201}$ has a quadrupole moment $3 \times 10^{-25}$, in fact requires a correction term when applied to a nucleus having a quadrupole moment. Recalculation using the corrected Inglis formula indicates that the two h.f.s. components of $Hg^{199}$ (B) and $Hg^{201}$ (C) which were found previously to have a separation of $9 \times 10^{-3}$ cm$^{-1}$. actually coincide in position within $\pm 1 \times 10^{-3}$ cm$^{-1}$.; a table of the corrected h.f.s. component separations is given. J. E. K.

**4520. Hyperfine Structure Interval Rule in Indium. D. H. Tomboulian and R. F. Bacher.** *Phys. Rev.* 54. *pp.* 446–447, *Sept.* 15, 1938.—Interferometric measurements on $\lambda$7182 ($5s6p^3P_1 \rightarrow 5s6s^3S_1$) and $\lambda$7276 ($5s6p^3P_0 \rightarrow 5s6s^3S_1$) of In II indicate that the separations of the state $5s6s^3S_1$ follow the interval rule to within the experimental error (approximately 0·05%). Perturbations by neighbouring states are negligible and there are no effects for this state due to the known electric quadrupole moment of the nucleus. The results indicate that the assumption of a nuclear magnetic moment is very successful in accounting for the observed relative separations. AUTHORS.

**4521. Nuclear Spin of Iodine. Part III. S. Tolansky and G. O. Forester.** *Roy. Soc., Proc.* 168*A*. *pp.* 78–103, *Oct.* 10, 1938.—Earlier measurements by Tolansky [see Abstract 5006 (1935)] upon the fine structures in the lines of the first-spark spectrum of I are extended into the u.v. region with the aid of a quartz Lummer plate interferometer. Fine structures are now known for 58 lines, 39 of which have been allocated to terms which go either to the ($^4$S) or the ($^2$D) series limit. An independent fine-structure analysis is made for both the systems and is confirmed by the aid of intercombination u.v. lines. Fine-structure interval factors are given for 13 ($^4$S) terms and 15 ($^2$D) terms. These exhibit anomalies which can be explained as arising from configuration interaction perturbation. It is shown that the nuclear coupling of the $5p^3$ electrons in I is comparable with that of the 6*s* electron. In three terms, deviations from the interval rule have been established. These are attributed to nuclear electrical quadrupole moment. The perturbation constants have been calculated, but these cannot as yet be employed to give a numerical estimate of the quadrupole moment, since the coupling constants have not yet been evaluated. [See also Abstract 197 (1936).] AUTHORS.

**4522. Atomic Energy Levels of $p^n p$ and $d^n p$ Configurations. T. Yamanouchi.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 547–567, *July*, 1938. *In English.*—A general method is described for finding expressions for the atomic energy levels, in the case of more than two states with equal *LS*-coupling, by constructing the energy matrix. The method is then applied for $p^3p$ and $p^4p$ configurations, and the results are compared with experimental values. For $p^5p$ a special method is employed to take the spin-orbit interactions into account. The variations of the parameter values of $F_2$, $G_0$, $G_2$ for $2p^n3p$ ($n = 1, 2, \ldots 5$) configurations are shown graphically. The methods are then applied to $d^n p$ configurations. In this case the number of states is large, some of them arise many times, and in most cases the experimental data are incomplete. Consideration is, therefore, given chiefly to the highest multiplet states, whose terms are fully known. Each state of this multiplicity arises twice at most, so that the energy matrices are obtained without constructing the transformation matrices. Other levels are taken into account only when these terms are not sufficient to determine the parameters. Results are compared with the terms of $3d^n4p$ configurations, and satisfactory agreement between the observed and calculated values is found. N. M. B.

**4523. Infra-Red Absorption Spectra of Pyrrol, Thiophene and Furane. R. Manzoni-Ansidei and M. Rolla.** *Accad. Lincei, Atti*, 27. *pp.* 410–413, *April* 24, 1938.—The absorption spectra of pyrrol, thiophene and furane have been measured in the region 6–17 $\mu$. The results are tabulated together with Coblentz's observations and with the Raman spectra of these substances. In the infra-red spectrum of thiophene appear 4 bands which have no counterpart in the Raman spectrum, 4 Raman lines to which no infra-red bands correspond while 6 frequencies occurs in both spectra. In the case of pyrrol 6 frequencies are found in both spectra, 7 frequencies are observed in only one of them. In the vibrational spectrum of furane there are 7 frequencies which belong only to the Raman spectrum alone or to the infra-red spectrum alone, 5 bands can be found in both spectra while the equivalence of 4 more Raman lines with infra-red bands is dubious. L. K.

**4524. Infra-Red Absorption of Heterocyclic Compounds. J. Lecomte.** *Comptes Rendus*, 207. *pp.* 395–398, *Aug.* 17, 1938.—The absorption of heterocyclic compounds has been examined between 500 and 1350 $cm^{-1}$. Comparisons are made between pyridine and benzene, quinoline and naphthalene, etc. H. G. C.

**4525. Infra-Red Absorption Spectrum of $CH_3OH$. A. Borden and E. F. Barker.** *J. Chem. Phys.* 6. *pp.* 553–563, *Sept.*, 1938.—The absorption spectrum of $CH_3OH$ has been studied in the region from 2·5 to 26 $\mu$ using a grating spectrometer having a KBr fore prism. Bands observed at 3683, 2978, 2845, 2054, 1477, 1455, 1340, 1034·18 $cm^{-1}$. together with a broad band from 860 to 380 $cm^{-1}$. are typical parallel and perpendicular bands and indicate that the molecule is only slightly asymmetric. The moments of inertia obtained from the fine structure of the 1034·18 $cm^{-1}$. band are, $A = 35{\cdot}18 \times 10^{-40}$ gm.cm$^2$., $B = 33{\cdot}83 \times 10^{-40}$ gm.cm$^2$., $C = 6{\cdot}8 \times 10^{-40}$ gm.cm$^2$. The low-frequency band is probably due to the vibration of the hydroxyl hydrogen parallel to the O-H bond and perpendicular to the figure of the molecule and indicates that the OH group is not free to rotate, at least in the ground state. Some evidence of free rotation in states of high excitation is obtained. F. J. L.

**4526. Infra-Red Absorption Spectra of $CH_3OD$ and $CH_2DOD$. E. F. Barker and G. Bosschieter.** *J. Chem. Phys.* 6. *pp.* 563–568, *Sept.*, 1938.—The absorption spectra of $CH_3OD$ and $CH_2DOD$ in the vapour state have been examined between 2·5 and 24 $\mu$ using a grating spectrometer having a KBr fore prism. The broadness of the band at 1040 $cm^{-1}$. for $CH_3OD$ indicates that the molecule is further removed from axial symmetry than $CH_3OH$. The corresponding band for $CH_2DOD$ has two components arising probably from two forms of the molecule. The deformation vibration is single in $CH_3OD$ but has four components in $CH_2DOD$ indicating a separation of levels for which $CH_3OD$ is degenerate. Condensation from the vapour to liquid state modifies the frequencies of the bands considerably. F. J. L.

**4527. S-H Frequency of Mercaptans. D. Williams.** *Phys. Rev.* 54. *pp.* 504–505, *Oct.* 1, 1938.—The spectra of one aromatic and two aliphatic mercaptans have been studied in the region between 2·75 $\mu$ and 4·25 $\mu$. In addition to the bands near 3·3 $\mu$ arising from the C-H linkage, absorption maxima were observed at 3·85 $\mu$ in benzyl mercaptan, at 3·83 $\mu$ in *n*-propyl mercaptan, and at 3·80 $\mu$ in *n*-butyl mercaptan. These bands are attributed to a vibration of the S-H group. The data obtained in the present study are compared with the existing Raman data and with the infra-red bands arising from the O-H group. Author.

**4528. Absorption Spectra of Cyclopropane, Ethylene Oxide, Ethylene Sulphide, and Ethylene Imine in the Photographic Infra-Red. E. H. Eyster.** *J. Chem. Phys.* 6. *pp.* 576–579, *Oct.*, 1938.—The absorption spectra of cyclopropane, ethylene oxide, ethylene sulphide, and ethylene imine have been investigated in the region between 7000 and 12,000 Å and the stronger bands have been assigned as third harmonics of the fundamental C-H stretching frequencies of these molecules. Rotational fine structure was not observed under high dispersion, but the well-defined band envelopes of the three asymmetric rotators provide interesting examples of these little investigated band types. Author.

**4529. Spectrum of Allene in the Photographic Infra-Red. E. H. Eyster.** *J. Chem. Phys.* 6. *pp.* 580–585, *Oct.*, 1938.—The spectrum of allene between 7000 and 12,000 Å has been photographed under high dispersion, the observed bands being assigned as harmonics and combinations of fundamental frequencies of the molecule. Rotational analysis of the parallel band at 11,444 Å has given $97·0 \times 10^{-40}$ gm.$cm^2$. as the large moment of inertia. The perpendicular band at 11,017 Å has been found to be unexpectedly complicated, but was too weak for detailed analysis. It has been concluded that the dimensions in ethylene and allene are: C-H = 1·087 Å, C = C = 1·330 Å, H-C-H = 116°. Author.

**4530. Infra-Red Absorption and Association in Carboxylic Acids. A. M. Buswell, W. H. Rodebush and M. F. Roy.** *Am. Chem. Soc., J.* 60. *pp.* 2240–2244, *Sept.*, 1938.—The general character of the infra-red absorption spectra indicative of H bonding is discussed. Curves are shown for the absorption of the active or bonding H in acetic, benzoic and deuterobenzoic acids under various conditions. The generalisation of Venkateswaran in regard to the shift of the OH frequency is confirmed and some suggestions are made to explain the complex absorption characteristic of association in the carboxylic acids. [See Abstract 4058 (1937).] Authors.

**4531. Absorption Spectra and Molecular Structure. Parts II and III. S. Kato and F. Someno.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, Nos.* 812–813. *pp.* 905–921, *Aug.*, 1938. *In English.*—Continuing previous work [see Abstract 5347 (1937)] the absorption spectra of phenol and its derivatives and of derivatives of organic acids are investigated. In each case the spectrum is described and then the molecular structure is discussed at length. In the case of phenol it is concluded that the absorption is definitely due to the single-bonded O atom, and it is suggested that the normal and excited orbitals of O should be nearly the same for phenol and anisol. In the case of the organic derivatives the conclusion is reached that there must be some kind of interaction within the carboxyl system of bonds, also, that the normal and excited orbitals of the non-bonding electron belonging to the single-bonded O in the molecule are located close to the C = O group, in which strong polarity causes the attractive interaction. A. H.

**4532. Absorption Spectra of Azo-Compounds and Halochromism. T. Uémura and Y Inamura.** *Chem. Soc. Japan, Bull.* 13. *pp.* 509–516, *Aug.*, 1938. *In French.*—Absorption spectra of solutions of azobenzene, disazobenzene, phenyl azo-diphenyl, azodiphenyl, benzene azo-α-naphthalene, α, α′-azonaphthalene, α, β′-azonaphthalene, and β, β′-azonaphthalene in benzene and in concentrated $H_2SO_4$ are recorded by the Hartley-Baly method. The results are discussed with reference to halochromism. C. B. A.

**4533. Absorption Spectra of Salicylaldehyde-ethylenediimine and Related Compounds. R. Tsuchida and T. Tsumaki.** *Chem. Soc. Japan, Bull.* 13. *pp.* 527–533, *Aug.*, 1938. *In English.*—Absorption spectra of benzaldehyde-ethylenediimine, *o*-methoxybenzaldehyde-ethylenediimine, salicylaldehyde-ethylenediimine and *o*-hydroxyacetophenone-ethylenediimine have been measured, and the structures of the spectra are qualitatively explained by the theories of absorption spectra of coordination compounds. The longest-waved band of salicylaldehyde-ethylenediimine as well as of *o*-hydroxyacetophenone-ethylenediimine is explained as due to intramolecular formation of a H bridge between the OH group and the N atom. In other words an absorption band of a H bond has been found in the near u.v. region. The absorption spectrum of salicylaldehyde-ethylenediimine-cobalt is explained and the steric configuration of the inner complex is thereby corroborated. AUTHORS.

**4534. Absorption Spectra of Metal Complexes of 2, 2′-Dipyridyl. Part II. K. Yamasaki.** *Chem. Soc. Japan, Bull.* 13. *pp.* 538–542, *Aug.*, 1938. *In German.*—Absorption spectra between 2200 and 7000 Å at room-temperature are recorded for 2, 2′-dipyridyl in hexane and in water, and for $[Mn(Dip)_2]Cl_2$, $[Co(Dip)_2Cl_2]Cl$ and $[Co(Dip)_2CO_3]Cl$ in water [(*Dip*) = dipyridyl]. The decomposition of $[Mn(Dip)_2]Cl_2$ in dilute solution is established. [For Part I see Abstract 4981 (1937).] C. B. A.

**4535. Absorption Spectra of αβ-Unsaturated Cyclic Carbonyl Compounds and their Dihydro-Derivatives. R. G. Cooke and A. K. Macbeth.** *Chem. Soc., J. pp.* 1408–1413, *Sept.*, 1938.—Quantitative measurements of the absorption spectra of a series of αβ-unsaturated cyclic carbonyl compounds show that the substances have two maxima of absorption, one of comparatively low intensity in the region 3120–3190 Å, the other of high intensity in the region 2260–2355 Å. The former is due to the CO group influenced by the double bond, $C=C\cdot\overset{*}{C}O$, and the latter,

to the ethenoid linkage influenced by carbonyl, $C = C \cdot \overset{*}{C}O$. In the case of phellandral with its conjugated aldehyde group, the intensity of the $C = C \cdot \overset{*}{C}O$ band is 8 – 11 times greater than is observed in the ketones examined. The absorption spectra of cuminal and cuminic acid are respectively in good agreement with the data of typical aromatic aldehydes and acids. AUTHORS.

**4536. Absorption Spectra of 4-(*p*-Dimethylaminostyryl) pyridine Methiodide and 2 : 4-Di-(*p*-Dimethylaminostyryl) pyridine Methiodide. G. R. Clemo and G. A. Swan.** *Chem. Soc., J. pp.* 1454–1455, *Sept.*, 1938.—*p*-Dimethylaminobenzaldehyde has been condensed with the methiodides of 4-methyl- and 2 : 4-dimethyl-pyridine, and the absorption spectra of the products have been plotted. AUTHORS.

**4537. Absorption Spectrum of the Permanganate Ion in Crystal Lattices. J. Teltow.** *Zeits. f. phys. Chem.* 40. *Abt.B.* 6 *pp.* 397–430, 1938.—The visible absorption spectrum of $MnO_4'$ ions has been examined at the temperature of liquid $H_2$ in crystalline solid solution with colourless salts, and in thin layers of pure permanganate. Crystal-embedded $MnO_4'$ ions exhibit two band systems, (I) and (II), in the green and red regions, (I) having an intensity much greater than that of (II). The position, interval and splitting-up of the bands are independent of the nature of the kations and the lattice symmetry. The broadening of the lines of (I), observed in many salts, is due to disturbance of electron terms by the environment existing at the absolute zero. The natures of the disturbing influences are indicated. In thin mixed crystals, with the same kations, (I) shifts towards longer wave-lengths with increasing space-filling of the lattice anions. (II) shows much more direction dependence than (I). In thin mixed crystals with $NaClO_4$ a wider red band exists in two directions of vibration, and a band system in the violet, which is observed in no other salt. Pure permanganate is strongly sensitive to visible light, but no sensitivity has been observed for thin mixed crystals, except $KIO_3$ and $KHSO_4$ with small amounts of permanganate. W. R. A.

**4538. Constitution and Absorption Spectrum of $HNO_3$. R. Dalmon.** *Comptes Rendus*, 207. *pp.* 473–475, *Sept.* 12, 1938.—The curve of molecular extinction coefficient $\epsilon$ at 3180 Å against molar concentration of $HNO_3$, aq. passes through a minimum at $23 \cdot 6\,N$, which is attributed to the formation of $N_2O_5$. The curves $\epsilon = f(\lambda)$ indicate an equilibrium between two components in the system. C. B. A.

**4539. Absorption Spectrum of Praseodymium Salts. A. Seidel and J. Larionov.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 683–686, 1938. *In English.*—The absorption of an aqueous solution of praseodymium sulphate is examined and the results are discussed in the light of a theory, originally due to Laporte, whereby the absorption is regarded as being due to transitions from the normal term belonging to the 4*f* configuration to outer shells. A. H.

**4540. Bands of $H_2$ Ending on the $2p^1\Pi$ Level. G. H. Dieke.** *Phys. Rev.* 54. *pp.* 439–445, *Sept.* 15, 1938.—New measurements make possible a much more complete analysis of the band systems ending on $2p^1\Pi$. The constants of this state can be obtained with great accuracy and the irregularities in the $\Lambda$-doubling and perturbations traced to the interaction with the higher vibrational levels of $2p^1\Sigma$. New information is obtained about some of the states which have both electrons excited. AUTHOR.

**4541. U.V. Band Spectra of Se, Te and their Oxides. Choong Shin-Piaw.** *Ann. de Physique*, 10. *pp.* 173–290, *Sept.*, 1938.—Several band systems have been found in the far u.v., due to Se and Te and are attributed to diatomic and polyatomic molecules. Two systems of bands due to SeO and one due to TeO have been found in the ordinary u.v., and a rich band-spectrum due to $SeO_2$ and $TeO_2$ in visible and u.v. By comparing the spectra of the elements with those of the monoxides and dioxides, a regular variation in spectroscopic properties has been shown for molecules of the same group. Some anomalies have been found in certain cases. F. S.

**4542. Vibrational Analysis for a New CuCl Band System Excited by Active Nitrogen. S. Bloomenthal.** *Phys. Rev.* 54. *pp.* 497–498, *Oct.* 1, 1938.—The CuCl band spectra in the near u.v., first observed by Strutt and Fowler who used active nitrogen excitation, were photographed and classified. The wave number of any band head in this system may be calculated from the formula :—

$$\nu = 25{,}282 + [383(v' + \tfrac{1}{2}) - 2(v' + \tfrac{1}{2})^2] - [415(v'' + \tfrac{1}{2}) - (v'' + \tfrac{1}{2})^2].$$

This band system has a common lower state with five other systems in the visible, observed in absorption and analysed by Ritschl. Author.

**4543. Near U.V. Band System of SnO. W. Jevons.** *Phys. Soc., Proc.* 50. *pp.* 910–913, *Nov.* 1, 1938.—The note refers to the papers of Connelly on SnO and of Jevons, Bashford and Briscoe on GeO [see Abstracts 4933 (1933) and 4538 (1937)]. In the latter it was pointed out that, judged by the data for related band systems of the monoxides of group-IV(*b*) elements, Connelly's values of the anharmonic coefficients $x_e\omega_e$ were anomalous, the value $3{\cdot}6$ cm$^{-1}$. for the ground state being slightly low, and the value $1{\cdot}1$ cm$^{-1}$. for the excited state being much too low. As a result of a re-examination of Connelly's band-head data the expression

$$\nu_{\text{head}} = 29624{\cdot}9 + (582{\cdot}6u' - 3{\cdot}08u'^2 - 0{\cdot}135u'^3) - (822{\cdot}4u'' - 3{\cdot}73u''^2)$$

is now proposed for the $A \rightleftarrows X$ system, and the anomalies are thereby removed. Author.

**4544. Temperature Dependence of Transition Probabilities in Absorption Spectra of Rare Earths. H. Ewald.** *Zeits. f. Physik*, 110. 7–8. *pp.* 428–435, 1938.—The dependence of the intensity of absorption lines in the double nitrate of Zn and Nd on crystal direction and temperature is investigated. The transition probabilities depend in an indefinite way on the crystal direction, and also on temperature and on special term combinations ; but the total intensity for all the lines in the group studied is independent of the crystal direction and temperature. The intensity sum for the lines starting from the ground term level II increases with temperature in accordance with the Boltzmann law.

C. B. A.

**4545. Test of Wave Mechanics in Molecular Spectra and Recent Developments in the Spectrum of $H_2$. O. W. Richardson.** *N. Cimento*, 15. *pp.* 232–245, *April*, 1938. *In English.*—This paper gives a brief account of recent improvements in the determination of some of the fundamental constants connected with the states of the hydrogen molecule, both experimental and theoretical. By comparing the results it can be seen how wave mechanics has overcome the test imposed on it by the existence of the $H_2$ molecule. The comparison is quite impressive. It then considers some properties of the molecular ion $H_2^+$. Finally it describes briefly some states of a type which so far have only been recognised in the hydrogen molecule and, in particular, two more of them

which have been found recently. These states are believed to have the electron in each atom excited. AUTHOR.

**4546. Graphical Representation of Energy States of a Diatomic Molecule. R. Schmid and L. Gerö.** *Ann. d. Physik*, 33. 1. *pp.* 70–88, *Aug.*, 1938.—A 3-dimensional coordinate system is developed for the graphical representation of the multiplicity of rotation and vibration states of diatomic molecules which is found generally to be more convenient and helpful than the use of potential curves, especially for representation of interactions between molecules such as perturbation and predissociation phenomena. The coordinates are energy, $J(J+1)$ and $b(\gamma)$, where $b(\gamma) = (b/8\pi^2 c\mu)(1/\gamma^2)$; the "term surfaces" are limited by the limiting curve of dissociation, the rotation sequence of the lowest vibration levels and by a curve giving the sequence of rotation constants as a function of the energy values of vibration levels. The application of this graphical method to the study of predissociation phenomena is illustrated with reference to the CO and earth alkali hydride spectra. J. E. K.

**4547. Calculations of Lower Excited Levels of Benzene. M. Goeppert-Mayer and A. L. Sklar.** *J. Chem. Phys.* 6. *pp.* 645–652, *Oct.*, 1938.—The energy of the first excited levels of benzene is calculated by the method of antisymmetrised molecular orbitals. The results predict two weak bands, due to forbidden electronic transitions, at $\lambda = 2500$ and $\lambda = 2100$ and a strong band at $\lambda$ 1500. No empirical data except the C–C distance in benzene were used. [See Abstract 4460 (1937).] AUTHORS.

**4548. Boric Acid Continuum Emitted by the Aureole of the Carbon Arc Light. W. Finkelnburg and H. Hess.** *Phys. Zeits.* 39. *pp.* 666–668, *Sept.* 15, 1938.—Experiments are described which indicate that the "borid acid spectrum" is emitted when B and $O_2$ meet in the flame or in the "Aureole" of the carbon arc light. The continuum is attributed to the formation of a B–O compound, in opposition to the interpretation of Walles [see Abstract 1498 (1933)]. W. R. A.

**4549. Fluorescence, Absorption Spectra and Conductivity of Aqueous Solutions of Fluorescein, Rhodamine and Acriflavin. I. C. Ghosh and S. B. Sengupta.** *Zeits. f. phys. Chem.* 41. *Abt.B.* 2. *pp.* 117–141, 1938.—For solutions of potassium fluoresceinate, acid salts of rhodamine B, and acriflavin, the absorption spectra in relation to the concentration, and the output in relation to cell thickness, wave-length of emission, wave-length and intensity of exciting light and concentration of solution has been investigated. The equivalent conductivities of the solutions were also measured. The fluorescent quantum efficiency (integrated over the region 4800 to 5800 Å) is independent of the exciting wave-length and for great dilutions independent of concentration. With increasing concentration the quantum efficiency decreases rapidly. It is concluded that deactivating collisions of the second kind do not occur but that the decrease of efficiency is due to the building of non-fluorescent micelles at high concentrations. The existence of these micelles is considered to be indicated also by the results obtained for the conductivity at higher concentrations. J. E.

**4550. Infra-Red Absorption and Raman Spectrum of HCl. B. Vodar, R. Freymann and Y. Ta.** *J. de Physique et le Radium*, 9. *pp.* 282–286, *July*, 1938.—The absorption of gaseous and liquid HCl have been examined between $0{\cdot}8$ and $2{\cdot}1\mu$. The third harmonic (between $0{\cdot}9$ and $1{\cdot}0\mu$) could not be detected with 40 cm. of liquid. The second harmonic ($1{\cdot}23\mu$) is accompanied by a new band at $1{\cdot}29\mu$ which disappears

as the temperature is raised from − 80 to + 14° C. No corresponding frequency appears in the Raman spectra. The band is probably due to chain molecules, a type of association which explains the feebleness of the Raman and the strength of the infra-red bands. H. G. C.

**4551. Raman Spectra of Organic Bi-Cyclic Compounds. B. D. Saksena.** *Indian Acad. Sci., Proc.* 8*A*. *pp.* 73–100, *Aug.*, 1938.—The Raman spectra of naphthalene, decaline, tetralin, indene, *trans*-$\beta$-decalone and *trans*-$\beta$-decalol have been studied, the last two for the first time. Polarisation measurements have also been made in the case of all these compounds excepting *trans*-$\beta$-decalol. The molecular structures of decaline, tetralin and naphthalene have been studied in the light of polarisation data and the symmetries of the molecules. The results indicate a puckered structure for tetralin, and a centro-symmetric structure for naphthalene. In decaline the *cis* and *trans* lines have been separated ; the observed polarisation characteristics of these forms agree with the group theory results. The determination of the values of $\rho$ for all these substances has been made for the first time and the results are given in tables. AUTHOR.

**4552. Normal Modes and Frequencies of the Sulphur Molecule. S. Bhagavantam and T. Venkatarayudu.** *Indian Acad. Sci., Proc.* 8*A*. *pp.* 101–114, *Aug.*, 1938.—The normal modes and frequencies of the sulphur molecule have been worked out on the assumption that the eight atoms in the molecule occupy the corners of a puckered octagon. There are eleven modes of which four are single and seven are doubly degenerate. Two of the former type and five of the latter type are Raman active. One is inactive in both Raman and infra-red spectra and the others are active only in infra-red absorption. The results obtained in respect of the Raman effect of sulphur are in agreement with the above conclusions. Detailed expressions are derived for the normal frequencies by postulating three types of forces, namely, primary valence, directed valence and repulsive forces. [See following Abstract.] AUTHORS.

**4553. Raman Spectrum and Specific Heat of Sulphur. S. Bhagavantam and T. Venkatarayudu.** *Indian Acad. Sci., Proc.* 8*A*. *pp.* 115–118, *Aug.*, 1938.—Using the expressions derived for the vibrational frequencies of sulphur [see preceding Abstract] the force constants $K_1$, $K_2$ and $K_3$ referring respectively to primary valence, directed valence and repulsive forces are evaluated. The values obtained are $K_1 = 2{\cdot}309 \times 10^5$ dynes/cm. ; $K_2 = 0{\cdot}903 \times 10^{-11}$ dyne cm./radian and $K_3 = 0{\cdot}06665 \times 10^5$ dynes/cm. The frequencies calculated on the basis of these constants are compared with the observed Raman lines and infra-red absorption maxima and satisfactory agreement is obtained. The specific heat of sulphur is represented as the sum of a Debye function and a number of Einstein functions associated with the various normal frequencies. The calculated values compare favourably with the observed specific heats. AUTHORS.

**4554. Normal Frequencies of Phosphorous ($P_4$). S. Bhagavantam and T. Venkatarayudu.** *Indian Acad. Sci., Proc.* 8*A*. *pp.* 119–123, *Aug.*, 1938.—Assuming a potential energy function based on primary valence and directed valence forces, expressions are obtained by group theoretical methods for the normal frequencies of the tetrahedral molecule $P_4$. The numerical values of the observed frequencies are in agreement with the theoretical expressions and yield $K_1 = 1{\cdot}68 \times 10^5$ dynes/cm. and $K_2 = 0{\cdot}396 \times 10^{-11}$ dyne cm./radian for the primary valence and directed

valence force constants respectively. On the assumption that this value of $K_1$ refers to a single bond, the oscillation frequency that is to be expected of P ≡ P molecule is calculated as 742 and compared with the value 779 obtained from band spectra. The calculated specific heat at 9° C is 19·8 cal. which is in good agreement with the experimental value, namely 22·0 cal. AUTHORS.

**4555. Raman Spectrum of Diphenyl. S. K. Mukerji and S. A. Aziz.** *Indian Journ. Phys.* 12. *pp.* 271–282, *Aug.*, 1938.—The Raman spectrum of molten diphenyl has been studied carefully with a view to record and assign correctly the faint Raman lines. A few new lines not observed by previous workers have been recorded by carefully suppressing the continuous background with the help of suitable filters. It is pointed out that most of the ground frequencies of benzene are also observed in the case of diphenyl and that the characteristic frequency due to the C-C binding between the two benzene nuclei is 1283 $cm^{-1}$. AUTHORS.

**4556. Raman Effect of Ethyl Derivatives. J. Wagner.** *Zeits. f. phys. Chem.* 40. *Abt.B.* 6. *pp.* 439–449, 1938.—Extending previous theoretical work on methyl derivatives [see Abstract 2913 (1938)] the author considers ethyl derivatives as valency force systems with 3 masses, *i.e.*, $CH_3$-$CH_2$-X. An exact description of the chain frequencies is only possible when the atomic weight of the substituent X is not greater than 36. The valency forces calculated from observed Raman frequencies are considerably smaller than in the case of the methyl derivatives. The deductions are discussed. L. A. W.

**4557. Raman Spectra of ClO′, $ClO'_2$ and $BO'''_3$ Ions. T. G. Kujumzelis.** *Phys. Zeits.* 39. *pp.* 665–666, *Sept.* 15, 1938.—A saturated aqueous solution of NaClO shows, in addition to the Raman lines of $H_2O$, a displacement of 713 $cm^{-1}$. which is assigned to the ClO′ ion. On standing for five months the solution undergoes oxidation and its spectrum now shows three lines displaced from the exciting line by 713, 802 and 935 $cm^{-1}$. The 935 $cm^{-1}$. displacement arises from the $ClO'_3$ ion. To ascertain the origin of the 802 $cm^{-1}$. displacement a solution of gaseous $ClO_2$ was examined but it gave only one strong displacement of 935 + 8 $cm^{-1}$. By the action of NaOH on a solution of $ClO_2$ a mixture of $NaClO_2$ and $NaClO_3$ obtained which gave two displacements of 802 and 935 $cm^{-1}$. It is concluded that 802 $cm^{-1}$. belongs to the $ClO'_2$. The spectrum of a solution of $H_3BO_3$ is also given. W. R. A.

**4558. Raman Spectrum of Liquid Diborane. T. F. Anderson and A. B. Burg.** *J. Chem. Phys.* 6. *pp.* 586–591, *Oct.*, 1938.—The Raman spectrum of $B_2H_6(l)$ is found to contain an isotopic triplet ($\nu_1$) 793, 806, 821 $cm^{-1}$., a broad line ($\nu_2$?) 1108 $cm^{-1}$. and a very intense doublet ($\nu_3$?) 2102, 2523 $cm^{-1}$. as well as several weaker lines. Abnormally large values for the B-B, C-C and Si-Si bond force constants in $B_2H_6$, $C_2H_6$ and $Si_2H_6$ suggest that these bonds are compressed in these molecules by forces which may be associated with those which restrict internal rotation. The value of 55·3 ± 1·5 cal./deg. is calculated for the entropy of $B_2H_6(g)$ at 25°. Combined with the known heat of formation this value leads to a free energy of formation of − 30,000 ± 4000 cal. for $B_2H_6(g)$ at 25°. This large value does not truly indicate high stability, for diborane decomposes easily to form other boron hydrides. AUTHORS.

**4559. Variation of Raman Spectrum of Nitrate Solutions with Kation. E. R. Laird and F. M. Plesset.** *J. Chem. Phys.* 6. *pp.* 592–594, *Oct.*, 1938.—The strong Raman line from solutions of Cd, Ag and Pb

nitrates has been re-measured at varied concentrations, and the results of Grassmann confirmed, namely that the frequency shift diminishes with increasing concentration for Pb and Ag, and varies little for Cd. A qualitative explanation of this behaviour and that of $NaNO_3$ is suggested in the effect of the kations on the structure of water, and attention is drawn to the similar order of these nitrates in X-ray diffraction phenomena.

AUTHORS.

***4560. Apparatus for Raman Spectroscopy at Low Temperatures. G. Glockler and M. M. Renfrew.** *Rev. Sci. Instruments*, 9. *pp.* 306–308, *Oct.*, 1938.—An apparatus is described which permits the study of Raman spectra in the temperature range from 0 to − 180° C. Its horizontal position avoids the use of a prism needed with vertical arrangements and it is easily placed into the authors' present arrangement of light sources. [See also Abstract 1230 (1936).] AUTHORS.

***4561. Progress in Infra-Red Technique. M. Czerny and H. Röder.** *Ergeb. d. exakt. Naturwiss*, 17. *pp.* 70–107, 1938.—Developments since about 1930 are discussed under three sub-headings: (*a*) sources of radiation, (*b*) methods of detecting and measuring radiation (photographic, photoelectric and thermal, including the evaporagraphic technique), (*c*) methods of dispersion. A Bibliography is appended. D. H. F.

**4562. Recent Work in Infra-Red. F. Matossi.** *Ergeb. d. exakt. Naturwiss*, 17. *pp.* 108–163, 1938.—This paper is a review of infra-red research since 1930. The subjects dealt with are the infra-red spectra of single molecules and of solid bodies, the study of inter-molecular effects in liquids by infra-red methods, and certain special applications such as the scattering of infra-red radiation by powders and thin metal films. A Bibliography is appended. D. H. F.

**4563. Physics in Pharmacy. R. L. McFarlan.** *J. of Applied Physics*, 9. *pp.* 573–578, *Sept.*, 1938.—The applications of spectroscopy, fluorescence, colorimetry, polarisation, refractivity, photoelectricity, X-rays, and other electrical phenomena to pharmacy are described. A. J. M.

*See also* Abstracts 4275, 4278, 4310, 4583.

## TRANSMISSION.

***4564. Spectral Transmissions of Absorbing Screens for Photometry. G. Déjardin, D. Cavassilas and R. Minangoy.** *Rev. d'Optique*, 17. *pp.* 41–60, *Feb.*, 1938.—A set-up employing a photo-cell and a single stage amplifier is described for the measurement of the spectral transmissions of light filters in the range 10000 to 3000 Å. For optical densities between 0·25 and 1·5 the accuracy varied from 0·003 to 0·010. Results are given for a number of Pt sputtered quartz plates. Comparison with spectral transmissions determined by photographic photometry shows the superiority of the present method. W. S. S.

***4565. Designation of Filters for Theatrical Lighting. D. B. Judd.** *J.O.S.A.* 28. *pp.* 390–397, *Oct.*, 1938.—The basis of this proposal is that the complete definition of the chromatic properties of filters used in illumination is transmission as a function of wave-length; an approximate definition suitable for commercial specification should, therefore, take the form of an abbreviated notation for the curve of spectral transmission. It is proposed to specify filters for theatrical lighting by a seven-digit number, the first digit of which refers to spectral transmission at

the short-wave extreme of the spectrum, the second, that at some longer-wave portion, and so on throughout to the long-wave extreme. The present paper discusses choices of wave-lengths to which the digits should refer and also what range of transmission should be indicated by digit, 0, what by digit, 1, what by digit, 2, and so on for maximum usefulness of the specification. Recommended choices are presented based upon a spectrophotometric examination by **W. F. Little** and **A. E. Parker** made upon two groups of theatrical gelatins, one group of 11 pink filters and one group of 11 blue filters. AUTHOR.

*See also* Abstracts **4350**, **4502**.

## VISION.

**4566. Eye and Brain as Factors in Visual Perception. R. H. Thouless.** *Nature*, 142. *pp.* 418–421, *Sept.* 3, 1938. *From Presidential Address to the British Assoc.* (*Sect. J*), *Cambridge, Aug.*, 1938.—Contrasts the " transmission theory " of vision (in which the formation of an optical image on the retina is considered to be transmitted by the optic nerve to the visual centres in the cortex and so to determine completely the impression received) with the newer theory in which perception may be likened to the construction of a chart showing isobars from information received from a limited number of stations. On this theory there is room for the individual variations which are actually found among observers in suitably designed experiments. Some of these are described and certain practical consequences which follow are mentioned. J. W. T. W.

**4567. Optical Resolution and Visual Examination of Two Overlapping Photographic Images. J. K. Robertson and R. H. Hay.** *Phil. Mag.* 26. *pp.* 495–501, *Oct.*, 1938.—An examination of resolving power has shown that microphometer traces of photographic diffraction images are at least 10% more effective than visual observation, the microphotometer detecting a minimum whose theoretical intensity is only a few per cent less than that of the neighbouring maxima. Evidence is given that observation of the photographic images either visually through a magnifier or by enlarged positives is nearly as sensitive a test of resolution as the microphotometer, although in these methods it is necessary to guard against a possible illusory effect. AUTHORS.

***4568. Diving Glasses. J. Mendousse.** *Rev. d'Optique*, 17. *pp.* 113–121, *March*, 1938.—For seeing under water, watertight goggles which prevent the water from coming into contact with the eyes may be used. Alternatively corrective glasses may be worn which compensate for the almost complete loss of the corneal refraction. A form of corrective glass is described comprising a plane parallel front component and a plano-convex rear component which together with a cylindrical ring form an air cell. Design details are given and a photograph of the finished spectacles. W. S. S.

**4569. Stereoscopic Drawings. J. T. Rule.** *J.O.S.A.* 28. *pp.* 313–322, *Aug.*, 1938.—The principles to be applied in the production of stereographs are illustrated by a number of examples and discussion of mirror and lens stereoscopes. The problem cannot be reduced to a rigid mathematical system and the principles laid down can only be a general guide. H. G. C.

*See also* Abstracts **4466**, **4508**, **4509**.

## X-RAYS.

**4570. Reflection Patterns of X-Rays with Crystals. T. Fujiwara and I. Takesita.** *Hirosima Journ. Sci.* 8. *pp.* 297–302, *Aug.*, 1938. *In English.*—X-ray reflection patterns with the crystal face (100) of rock-salt were taken by using divergent X-rays from a point source of copper and zinc ; and the same kind of reflection patterns previously obtained by H. Seemann [see Abstract 1555 (1931)] are discussed on the basis of the present experiment. AUTHORS.

**4571. Effect of a Direct Electric Field on Laue Diffraction Photograms. A. Němejcová and J. Brož.** *Phys. Rev.* 54. *pp.* 379–384, *Sept.* 1, 1938.—The effect of a direct electric field on the Laue photograms of silica, mica and gypsum is investigated. Under the action of the field the intensity of the Laue reflections is increased, and the central spot is made narrower. If the field is applied to the crystal through Al coatings deposited on the surface by evaporation, the narrowing of the central spot increases only up to a certain intensity of the field. If the field is applied for a longer time or with aged Al coatings the difference in the central spot, with and without the electric field, disappears. The narrowing of the spot is caused by alterations produced in the crystal lattice by the field. The phenomena are explained partly by the perfection of the lattice, partly by the shift of the positive and negative ions of the crystal and the positive metallic ions of the Al coatings, which take place in a direct electric field. C. J. B. C.

***4572. Moseley Law X-Ray Tube for Atomic Physics Laboratories. B. Sway and D. A. Wells.** *Am. Phys. Teacher*, 6. *pp.* 208–211, *Aug.*, 1938.—It is considered that the work of Moseley on the frequency of the characteristic X-ray lines of the elements is one of the classic experiments forming the dawn of atomic physics. The repetition of this experiment for demonstration purposes is made easy by the X-ray tube designed and described by the authors. The tube is of the gas type, continuously evacuated and water-cooled. The anode carries six targets of different metals and is rotatable to bring any one of the targets into action. The metals are Cr, Fe, Co, Ni, Cu and Mo. Details of the vacuum and electrical systems are given, the latter being self-rectifying. A simple camera is described and typical photographs reproduced. From these are obtained the data for the curve verifying Moseley's law. E. H. W. B.

**4573. K-Spectra of As, Se and Br. M. L. Allais.** *Comptes Rendus*, 207. *pp.* 450–452, *Aug.* 29, 1938.—The wave-lengths of the lines $\beta_1$, $\beta_2$ and $\beta_3$ in the K-emission spectra of As, Se and Br are measured using a spectrometer which has a dispersion of 5·9 X.U. per mm. The $\beta_1\beta_3$ doublet is clearly resolved. F. J. L.

**4574. Ionisation of Air by X-Rays of Different Hardness and Different Degrees of Homogeneity up to 400 kV. W. I. Block.** *Ann. d. Physik*, 32. 8. *pp.* 701–733, *Aug.*, 1938.—The ionisation due to X-rays of 200–400 kV, rendered extremely homogeneous by filtering through lead and tin, was investigated for 8 cylinders ranging from 11 to 70 cm. dia., in connection with the results previously obtained by Küstner [see Abstract 655 (1928)]. Careful regard being paid to all disturbing effects, it was found that for 380 kV, 2·9 mm. Pb+8 mm. Sn+1 mm. Cu+9 mm. Al (half-value thickness=6·6 mm. Cu) and all weaker rays, a chamber dia. of 60 cm. sufficed for the full utilisation of the carrier formation and hence for the determination of the absolute "r"-unit. For rays

of 400 kV, 3·7 mm. Pb+8 mm. Sn+1 mm. Cu+9 mm. Al (half-value thickness=6·85 mm. Cu) a chamber dia. of 70 cm. was not sufficient. For the ionisation in chambers of insufficient dia. curves were obtained which extend those of Küstner in the short-wave region. The continuous displacement of the minima and maxima with change of the ray hardness and also with the degree of homogeneity, shows the laws previously found by Küstner are obeyed. Confirmation was also obtained of Küstner's explanation of the reciprocal action between photoelectrons and Compton electrons in the ionisation of air. Investigation of small chambers (thimble chambers) showed that each element of their volume furnished the same contribution to the total ionisation. It was therefore found possible to determine the true intensity distribution from point to point of a non-uniform or variable intensity radiation field. Investigation of beams of 220 and 400 kV respectively in a dispersive medium (water) showed that, in agreement with the Compton effect, the sharpness of the depth delimitation increases with increasing hardness of the beam. For two entrance fields of 25 and 94 $cm^2$. respectively, on changing from 220 kV, 0·5 mm. Cu+1 mm. Al (half-value thickness=1·15 mm. Cu) to 400 kV, 2·55 mm. Sn+0·5 mm. Cu+1 mm. Al (half-value thickness=5·1 mm. Cu), at 10 cm. depth in water an increase of the dosage was observed of 18 and 15% respectively. A, W.

**4575. Method of Gas Analysis Based upon the Optical-Acoustic Tyndall-Röntgen Effect. M. Veingerov.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 687–688, 1938. *In German.*—A method of gas analysis, based upon the phenomenon of the excitation of audible vibrations by the incidence of suitably interrupted radiation upon a solid or gas—an effect studied by Bell in 1880, and later by Tyndall and Röntgen—is suggested. Suitable apparatus is described. J. S. G. T.

*See also* Abstracts **4280, 4312, 4563, 4711, 4712, 4715, 4716, 4717,** and **3257B.** Analysis by X-Ray Diffraction. J. D. Hanawalt, H. W. Rinn and L. K. Frevel.

# HEAT.

## CALORIMETRY.

**4576. Specific Heat-Temperature Curves of Age-Hardening Alloys. N. Swindells and C. Sykes.** *Roy. Soc., Proc.* 168*A*. *pp.* 237–264, *Oct.* 25, 1938.—The changes in atomic configuration taking place during hardening affect the apparent specific heat of age-hardening alloys. Specific heat-temperature curves and hardness measurements have been obtained on five typical age-hardening alloys. The results show that in certain cases, *e.g.* the Ag-Cu and Cu-Be alloys, maximum hardness is attained when the major portion of the chemical energy associated with the supersaturated solid solution has been evolved, *i.e.* precipitation has taken place. In other cases, duralumin and Al-Cu alloys, maximum hardness is associated with segregation of the solute atoms in the parent lattice prior to precipitation. Authors.

*See also* Abstracts **4306, 4552, 4553, 4554, 4585, 4587.**

## CONDUCTION.

**4577. Theory of Heat Conduction. H. S. Carslaw and J. C. Jaeger.** *Phil. Mag.* 26. *pp.* 473–495, *Oct.*, 1938.—Various problems

involving linear or radial flow of heat are solved by a method in which the partial differential equation representing the heat flow is first multiplied by $e^{-pt}$, where $p>0$, and is then integrated with respect to $t$ from 0 to $\infty$. Frequently the solution can then be obtained from a table of Laplace transformations, or, failing this, it may be evaluated by reduction of the inversion function. R. W. P.

*See also* Abstracts 4330, 4353, and
3118B. Heat Transfer to Boiling Liquids. E. T. Sauer, H. B. H. Cooper, G. A. Akin, and W. H. McAdams.

## CONVECTION.

**4578. Thermal Effects on Bodies in an Air Stream. W. F. Hilton.** *Roy. Soc., Proc.* 168*A*. *pp.* 43–56, *Oct.* 10, 1938.—Pohlhausen's equation for the temperature at the surface of a flat plate with a laminar boundary layer has been verified to within the limits of experimental accuracy. The theoretical temperature slope ($\alpha=0\cdot633$) is in excellent agreement with the experimental value found near to the leading edge ($\alpha=0\cdot636$) where the flow is probably laminar. The result near to the trailing edge ($\alpha=0\cdot504$) is consistent with the flow being turbulent in this region. The linear relation between $\delta T$ and $V^2$ breaks down at high speeds, due to the formation of shock waves, and an inflection occurs in the curve. By measurements of total head in the wake, and by force measurements on the balance, it has been verified that this inflection is caused by a shock wave. Thus thermocouples may be used to detect the presence of shock waves, and it is suggested that by placing thermocouples on models of aeroplanes, or even on actual aeroplanes in flight, the parts giving rise to shock waves could easily be found, and modified to obtain a higher top speed. Tests were also made on a steel streamline bar at various incidences and Pohlhausen's equation has been extended to apply to this case, but a rigid verification could not be effected, due to the unknown effect of heat conduction along the metal streamline bar. It is hoped to carry out further tests on aerofoil sections made of heat insulating material, and to compare the values of $n$ found by the present method with those found by direct experiment. Agreement is to be expected over the nose of the aerofoil where the flow will be laminar, but a difference should be found behind the point of transition to turbulent flow. A circular cyclinder placed across stream was found to be a most unsatisfactory shape for a thermometric element, since its temperature varies from nearly the adiabatic compression temperature at the front, to nearly the free stream temperature at the rear. The ideal method of measuring the temperature of a moving fluid would be to move a thermometric element of any shape with the same velocity as the fluid, but since this would usually be impracticable, the best method is to use a stationary flat plate, with the sensitive area in the region of laminar boundary layer flow. AUTHOR.

**4579. Calculation of Temperatures of Strongly Heated Rods and Wires. J. Fischer.** *Zeits. f. Physik,* 110. 7–8. *pp.* 397–427, 1938.—Equations are established by means of which approximate calculations can be made of the temperature distributions of rods, wires or strips when strongly heated at one end and cooled at the other, or when heated electrically and cooled at both ends. Allowances are made for heat losses by conduction, convection and radiation, and for the change in electrical resistivity with temperature. The equations, which hold good for excess temperatures of several hundred degrees, are used to solve a

number of problems which serve to illustrate the scope of the suggested methods. R. W. P.

## DILATATION.

*See* Abstracts 4309, 4354.

## FUSION AND SOLIDIFICATION.

**4580. Physical Chemical Properties of cis- and trans-Decahydronaphthalene. W. F. Seyer and R. D. Walker.** *Am. Chem. Soc., J.* 60. *pp.* 2125–2128, *Sept.*, 1938.—Pure forms of cis- and trans-decahydronaphthalene have been prepared and some of their physical properties measured. The freezing points were found to be higher than those so far recorded. The densities and refractive indices of nine mixtures of the two forms were measured and it was shown that both these properties were linear functions of the compositions. AUTHORS.

**4581. Solidification Diagram of Al-Cu Alloys. W. Broniewski, S. Jelnicki and M. Skwara.** *Comptes Rendus*, 207. *pp.* 233–235, *July* 18, 1938.—Al and electrolytic Cu are melted together *in vacuo* in a h.f. induction furnace, the alloys being homogenised for 250 hr. at 500° C. and cooled to room-temperature during 75 hr. Thermal points are observed at 1034° ($AlCl_3$), 952° $Al_2Cu_3$, 849° (AlCu), 589° ($Al_2Cu$), 574°, 570°, 548° ($Al_2Cu$ — Al eutectic), the existence of five compounds being deduced. D. R. H.

*See also* Abstract 4290.

## TEMPERATURE.

**4582. Temperature Scale and Thermionic Emission from Rhodium. H. B. Wahlin and L. V. Whitney.** *J. Chem. Phys.* 6. *pp.* 594–597, *Oct.*, 1938.—When Rh is heated to incandescence in an atmosphere of air or $O_2$ a coating forms on its surface. This is shown by a change in the emissivity. When the temperature is increased sufficiently this coating suddenly disappears, and when the temperature is lowered it reappears. This coating is probably an activated adsorption of $O_2$, or an oxide of Rh. It is found experimentally that the temperature and partial $O_2$ pressure at which the coating disappears are related by the Clausius-Clapeyron equation: $(d \log_e P)/dT = L/RT^2$. P is the partial oxygen pressure, $T$ the absolute temperature, and $L$ the heat of vaporisation of the surface. The electron work function of a clean Rh surface is found to be $\phi = 4{\cdot}80$ V, and $A = 33$ A/cm$^2$./degree$^2$. AUTHORS.

**4583. Temperature Measurement by the Method of Reversed Lines. H. J. Hübner.** *Ann. d. Physik*, 33. 1. *pp.* 52–56, *Aug.*, 1938.—The author describes a method by which the temperature of the reversal of spectral lines is obtained from the extrapolation of measurements of the brightness of the light-source under consideration. The usual continuous light source is used, but it is no longer necessary that the spectral line completely disappears. It is therefore possible to measure temperatures which are higher than the temperature of the reversing radiation. L. K.

***4584. Thyratron-Controlled Thermostat. J. M. Sturtevant.** *Rev. Sci. Instruments*, 9. *pp.* 276–279, *Sept.*, 1938.—A relatively inexpensive thermoregulator employing a resistance thermometer and phase-shifting thyratron circuit is described. Continuous control, precise to $\pm 0{\cdot}003$ °C., has been obtained in a water bath of average quality of design. AUTHOR.

**4585. Properties of Gaseous He at Liquid He Temperatures. A. van Itterbeek.** *J. de Physique et le Radium*, 9. *pp.* 313–318, *Aug.*, 1938.—The general history of the properties of He at low temperatures is given with special reference to the specific heat. Brief details are then given of the specific heat determination by measurement of the velocity of sound in the gas. The apparatus is illustrated but has been described elsewhere. The importance of the new conceptions of the de Broglie waves in this connection, and also the Bose-Einstein statistics is emphasised. Values for the viscosity were obtained by means of the Maxwell disc, and they were also calculated theoretically. The results are in very good agreement with the theory of Uehling. Curves are given showing that for $O_2$, $H_2$ and He at these temperatures the viscosity is sensibly independent of the pressure, and also for $O_2$ and $H_2$ at ordinary temperatures and low pressures. These results are considered to verify Maxwell's law of distribution of velocities and the variation with the square root of the absolute temperature. E. H. D.

## THERMOCHEMISTRY.

**4586. Heat of Combustion of Styrols. W. v. Luschinsky.** *Zeits. f. phys. Chem.* 182. *Abt.A.* 5. *pp.* 384–388, 1938.—The heats of combustion of monostyrol and of two different polystyrols have been measured, using the method of Roth. Polystyrol A is obtained by the polymerisation of monostyrol by heating at 180° C. for 6 hr. and polystyrol B is obtained from polystyrol A by fractional separation. The values obtained for the heats of combustion are 1045·4 kg.cal./mol. for monostyrol, 1034·8 kg.cal./mol. for polystyrol A and 1031·6 kg.cal./mol. for polystyrol B. Viscosity measurements were also made to determine the degree of polymerisation of these products. On the grounds of energy changes on polymerisation it is concluded that the C–C linkage in the polystyrols is weaker than in a normal molecule and this finding is compared with a similar result in the case of ethylene oxide and polyethylene oxide. G. G.

**4587. Heat of Formation and Specific Heat of Chromium Nitride. S. Satoh.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 819. *pp.* 1001–1009, *Sept.*, 1938. *In English.*—The mean specific heats of chromium nitrides were measured by the ice calorimeter over three temperature intervals: 0°∼99·5° C., 0° C.∼325·7° C. and 0° C.∼511° C. and the equations of the true specific heats within the limit of these temperature intervals were obtained.

$$Cr_2N: \quad C = 0{\cdot}150\,7 - 1{\cdot}165\,4 \times 10^{-5}T = 1{\cdot}253\,4 \times 10^{-7}T^2.$$
$$CrN: \quad C = 0{\cdot}209\,6 - 2{\cdot}328 \times 10^{-4}T + 3{\cdot}939 \times 10^{-7}T^2.$$

By using these values, the heats of formation of chromium nitrides were computed from their dissociation pressures measured at high temperatures. The results obtained are as follows: $2Cr + N = Cr_2N + 26340$; $Cr + N = CrN + 28260$. [See Abstract 2943 (1938).]

AUTHOR.

**4588. Theory of Uniform Flame Propagation. J. B. Zeldovich and D. A. Frank-Kameneckij.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *pp.* 693–697, 1938. *In English.*—Of the existing theories of flame propagation, only that of Lewis and v. Elbe [see Abstract 4247 [1934)] takes into account the kinetics of the chemical process, and they assume that up to a given temperature of ignition no reaction occurs. Actually the reaction velocity is not an explicit function

of time, but of the temperature and concentration of the reactants. The manner in which it depends on the time and on the distance from the flame front cannot be obtained before integrating the equation for propagation, and the resulting expression must, in particular, contain the required velocity of propagation. A general method of solving the complex differential equations involved is now suggested. H. H. Ho.

**4589. Thermal Explosion of $N_2O$. J. B. Zeldovich and B. I. Jacovlev.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 9. *p.* 699, 1938. *In English.*—The rapid increase of the velocity of decomposition of $N_2O$ with temperature, as well as the exothermic character of this reaction, has indicated the assumption that after the temperature and, accordingly, the rate of heat liberation had grown sufficiently high, the decomposition of $N_2O$ should proceed with self-ignition in an explosive manner. Experiments have confirmed this assumption, the self-ignition being accompanied by a blue flame and sharp rise in pressure. The self-ignition limit (data for which are included) has been calculated on the Frank-Kameneckij theory [see Abstract 3764 (1938).] H. H. Ho.

**4590. Combustion of Explosives. A. F. Belajev.** *Acta Physicochimica,* 8. 6. *pp.* 763–772, 1938. *In English.*—A theory of the combustion of explosives is based on the following assumptions: (1) the combustion takes place in the gaseous phase; (2) during the energy transfer to the surface layer of an explosive which, under the given conditions, is capable of combustion, the energy is used up chiefly in the evaporation of the explosive. In the more volatile explosives a stable state of combustion in the gas phase is attained more readily, and the production of detonation is more difficult than for the less volatile ones. A. J. M.

**4591. Hydrodynamical Theory of Detonation. H. Langweiler.** *Zeits. f. techn. Physik,* 19. 9. *pp.* 271–283, 1938.—The hydrodynamical theory of detonation, due to Chapman and extended by Becker is briefly, reviewed. Theories hitherto proposed are unsatisfactory in that they indicate that the products of detonation have a velocity in the direction of propagation of the advancing detonation front and this velocity is not considered in discussing the velocity of the complete system. The author develops a theory of detonation which does not necessitate the introduction of the notion of detonation temperature but is based upon directly measurable constants. The theory leads to a new definition of shattering power. The results obtained are applied to the case of trinitrotoluene. J. S. G. T.

*See also* Abstracts **4342, 4349, 4595.**

## THERMODYNAMICS.

**4592. Complete Diagram of State of Binary Systems with Vapour Pressure Maxima. Part II. E. Jänecke.** *Zeits. f. phys. Chem.* 182. *Abt. A.* 6. *pp.* 413–420, 1938.—The equilibrium diagrams for binary mixtures of which the constituents are isomorphous, and which show a minimum melting point are given and discussed. [For Part I see Abstract 3777 (1938).] A. J. M.

**4593. Classification of State of Gaseous He, Ne and A. R. A. Buckingham.** *Roy. Soc., Proc.* 168*A*. *pp.* 264–283, *Oct.* 25, 1938.—The problem of deriving the form of the interaction of rare gas atoms from their observed second virial coefficients is attacked by the method introduced by Lennard-Jones, using the classical equation of state and for

the interaction energy $E(r) = \lambda r^{-s} - \mu r^{-t}$. The method of calculation used by Lennard-Jones for He, Ne and A, assuming $\lambda$ and $\mu$ constant, has been modified and then extended to allow for a possible slow variation of $\lambda$ with $r$. The bearing of the results upon the true interaction of He atoms is discussed, mainly in relation to the accuracy of the Slater field. For Ne and A it is emphasised that an unambiguous determination of the interaction energy requires an accurate knowledge of the properties of the crystalline form of these elements. The description of the repulsive potential by analytic expressions, such as $be^{-r/\varrho}$ and $b_1 r^{\gamma} e^{-r/\varrho_1}$, is considered, and parameters deduced which give the best correlation of gas and crystal data, on the assumption that the above equation and kindred forms are valid for the interaction of neighbouring atoms only in the crystals.

AUTHOR.

**4594. Critical Temperature. I. Traube.** *Faraday Soc., Trans.* 34. *pp.* 1234–1235, *Oct.*, 1938.—The usual definition of the critical temperature as that temperature at which the liquid and the gas have the same density is criticised on the basis that both phases exist above this temperature. A number of references are cited in favour of this and the author's suggestion of two kinds of molecules, "gasons" and "fluidons", is briefly developed. This new theory is said to explain the deviations from the Andrews-van der Waals theory observed by so many workers. E. H. D.

**4595. Solution of Ions in Water. D. D. Eley and M. G. Evans.** *Faraday Soc., Trans.* 34. *pp.* 1093–1112, *Aug.*, 1938.—The authors consider the entropy changes which accompany the solution of a gaseous ion in water and give a thermodynamic equation, which represents the whole process. In it account is taken of the appropriate partition functions, the translational entropy of the ion in solution and the entropy of the ion in the gas phase. G. G.

**4596. Thermodynamic Properties of Methyl Bromide. C. J. Egan and J. D. Kemp.** *Am. Chem. Soc., J.* 60. *pp.* 2097–2101, *Sept.*, 1938.—The results of a calorimetric investigation on condensed $CH_3Br$ between 15° K. and the boiling point 276·66 ± 0·05° K. are given in detail. A transition occurred in the solid at 173·75 ± 0·15° K., with a heat of transition of 113·4 ± 1 cal./mol. Other measurements made were: melting point 179·44 ± 0·05° K., latent heat of fusion 1429 ± 2 cal./mol., latent heat of vaporisation 5715 ± 6 cal./mol., density of $CH_3Br$ gas at 298·10° K. and 1 atm. pressure 3·9739 ± 0·0009 gm./l. The results of vapour pressure measurements on the liquid were represented by the equation $\log_{10} P_{(Int.cm.Hg)} = -(1541{\cdot}437/T) + 8{\cdot}49274 - 0{\cdot}00424740T + 1{\cdot}7599 \cdot 10^{-6} T^2$ over the range 203 to 278° K. (0° C. = 273·10° K.). The entropy of $CH_3Br$ (ideal gas) at the boiling point and 1 atm. was calculated from the calorimetric data and found to be 57·86 ± 0·10 cal./mol. deg. At 298·10° K. the entropy was 58·61 cal./mol. deg. The corresponding spectroscopic values for the entropy are 57·99 and 58·74 cal./mol. deg. S. W.

**4597. Thermodynamics of HCl in Dioxane-Water Mixtures from E.M.F. Measurements. Part V. H. S. Harned and J. G. Donelson. Part VI. H. S. Harned and C. Calmon. Part VII. H. S. Harned, J. G. Donelson and C. Calmon.** *Am. Chem. Soc., J.* 60. *pp.* 2128–2135, *Sept.*, 1938. [See also Abstract 1689 (1938).]

**4598. Exchange of Deuterium Between $CH_3OH$ and $D_2O$. J. O. Halford and B. Pecherer.** *J. Chem. Phys.* 6. *pp.* 571–575, *Oct.*, 1938.—New measurements of the equilibrium in the exchange reaction

between methanol and heavy water, in conjunction with data in the literature, are considered in relation to the vibrations of the hydroxyl group, including the torsional degree of freedom. An interpretation is presented which allows for a torsional frequency of 250 $cm^{-1}$., a value which is shown to be in reasonable agreement with the entropy from thermal data. AUTHORS.

*See also* Abstracts 4309, 4639.

## VAPORISATION AND CONDENSATION.

***4599. Plate Efficiency of Fractionating Columns. D. B. Keyes.** *Univ. of Illinois Eng. Exp. Sta., Circ. No.* 35. [14 *pp.*], *July* 8, 1938.—The author briefly reviews previous work on column design and discusses the fundamental factors involved in the determination of plate efficiencies. Entirely theoretical. S. W.

**4600. Evaporation of Water into Quiet Air. B. F. Sharpley and L. M. K. Boelter.** *Indust. and Engin. Chem.* 30. *pp.* 1125–1131, *Oct.*, 1938.—The evaporation from a pan of 1 ft. dia. of distilled water into quiet air at 53% humidity was measured for water temperatures between 63° and 93° F. The surface of the water was at the level of the surroundings. In the critical region, corresponding to a water temperature of 69·4° F, the buoyant effects of the mixture at the water surface and far away are equal. The unit evaporation rate above the critical region, in lb./$ft^2$./hr. may be expressed by the equation: $e = -0{\cdot}024 + 65(c_{vw} - c_v)$. Below the critical region the results may be expressed approximately by the equation: $e = 18{\cdot}75(c_{vw} - c_{v_\infty})$, where $c_{vw}$ is the concentration of water vapour on the gas side of the gas-liquid interface and $c_{v_\infty}$ is the concentration of the water vapour in the atmosphere far from the pan, both in lb./$ft^3$. A tentative correlation with thermal free convection data has been accomplished.

**4601. Evaporation from Free Water Surface by Perpendicular Air Stream. M. C. Molstad, P. Farevaag and J. A. Farrell.** *Indust. and Engin. Chem.* 30. *pp.* 1131–1138, *Oct.*, 1938.—Circular water surfaces of areas ranging from 0·05 to 0·37 $ft^2$. have been subjected to a perpendicular air stream having velocities from 3 to 15 ft./sec. (corresponding to mass velocities, G, of approximately 800–4000 lb./$ft^2$./hr.). Tests at prevailing room temperature and humidity and at the lower velocities gave evaporation coefficients ($k'$ = lb. evaporated/$ft^2$./hr./unit humidity difference) which were about 50% greater than the accepted coefficients for evaporation of water to an air stream flowing parallel to the surface. The coefficients were found to fall on a line having the equation: $k' = 1{\cdot}42\ G^{0.37}$. The heat transfer coefficient in this case of forced convection is given as $h_c = 0{\cdot}37\ G^{0.37}$. Tests with air streams at 125°, 175° and 225° F. gave the same evaporation coefficients as the tests at room temperature. Coefficients in still air were only about 2% of those at the lowest air velocity. In a limited number of drying tests on Celotex insulating board, the evaporation coefficients during the constant rate period were substantially the same as those for water under the same conditions.

*See also* Abstracts 4281, 4282.

# ACOUSTICS.

**4602. Dunkerley's Frequency Formula. E. Jouguet.** *Comptes Rendus*, 207. *pp.* 413–417, *Aug.* 22, 1938.—If a vibrating system is subjected to certain controls, and to forces possessing a potential, and if the vibrating masses are changed from $m_1$ to $m_2$ then to $m_1 + m_2$, the corresponding frequencies of the system $f_1$, $f_2$ and F, will be related by $\frac{1}{F^2} \geq \frac{1}{f_1^2} + \frac{1}{f_2^2}$. The sign for equality gives Dunkerley's formula. Examples dealing with torsional vibrations, vibrations of loaded strings and critical speeds of a bent shaft are employed to show that the inequality often borders on equality, and that the formula is in many cases sensibly exact. This is due to the small amount of variation of a function when in the neighbourhood of its maximum. G. E. A.

**4603. Equivalent Lengths and Length Corrections in Acoustic Systems. F. H. van den Dungen.** *Rev. d'Acoustique*, 7. *pp.* 1–19, *Jan.–March*, 1938.—The lengths referred to are those of the equivalent cylindrical pistons of air in the necks of resonators. The author investigates approximate values of the length corrections, using a principle given by Rayleigh. This leads to expressions that supply higher and lower limits for the frequency of the fundamental of the resonator, and consequently to lower and higher limits for the equivalent length or the correction. The cases of the pipe closed at one end and other forms of resonator are dealt with, and arithmetical values are found for a spherical resonator with cylindrical neck, and the limits found are compared with those obtained from Rayleigh's formula. G. E. A.

**4604. Maintenance and Stabilisation of Singing Flames. Z. Carrière.** *Rev. d'Acoustique*, 7. *pp.* 20–36, *Jan.–March*, 1938.—The form of the jet and its end-pieces used in producing singing flames is shown. It has a listening device in the form of a stethoscope. The following results are given. The singing flame is maintained and stabilised by an internal wave in the feed-tube, but no nodes or loops have been observed. As the frequency of the flame depends chiefly on the speed of flow of the gas near the diaphragm which causes the note, all disturbances which set up turbulent flow will alter or suppress the note. The tendency to sound is due to gaseous whirls, generated at the edge of the diaphragms used, which change into ring vortices, carried on by the gas, equidistant in time and space, and invisible below the blue edge of the flame. The height of this edge is determined by the first maximum of a Bessel function of high order which represents the internal expansion of a conical jet of gas. This is the first fringe of the flame evoked by the arrival of a ring vortex. After this the conical form no longer persists, and the fringes move vertically at nearly constant speed. The sudden and periodic break-up of the cone at the arrival of successive rings explains the localisation of the sound in the blue edge. This edge source reacts back on the diaphragm, from which may be explained various stabilities according as the gas is lit or not. Two forms of pseudo-singing flames are described which exhibit no stratification. In one case the author found, by stroboscopic means, fringes of frequency 9139. G. E. A.

**4605. Motion of Loaded Vibrating String. D. N. Sen and R. Kumar.** *Calcutta Math. Soc., Bull.* 30. *pp.* 1–4, *March*, 1938.—Mathematical. When a string is loaded symmetrically at $n$ points, the loads

diminish the frequency except in the case of the normal modes of order $k(n+1)$, when the points where the masses are placed become nodes ($k$ = a constant). It is also shown that the disturbed frequencies may be made to approach the undisturbed ones by suitable loading. G. E. A.

**4606. Velocity of Sound in Liquid Helium. J. C. Findlay, A. Pitt, H. G. Smith and J. O. Wilhelm.** *Phys. Rev.* 54. *pp.* 506–509, *Oct.* 1, 1938.—The velocity of sound in liquid He under its vapour pressure has been determined by a supersonic method over a temperature range from 4·22° K to 1·76° K. From the measurements obtained, the compressibility of the liquid He has been computed. At temperatures not too close to the λ-point, the values are in fair agreement with those estimated from thermodynamical considerations, but the expected discontinuity at the λ-transition has not been observed. AUTHORS.

**4607. Velocity of Sound in Copper. G. E. Allan.** *Phil. Mag.* 26. *pp.* 609–614, *Oct.*, 1938.—Reference to tables shows that the velocity of sound in Cu varies from 3553–3984 m./sec. The velocity in a specimen of very pure Cu is measured by the monochord method and a mean value of 3846 m./sec. at 14·6° C is obtained but after annealing the value falls to 3730 m./sec. The temperature coefficient is small (velocity = 3852 m./sec. at 0° C. and 3815 m./sec. at 100° C.). H. J. H. S.

**4608. Supersonics. E. Baumgardt.** *Rev. d'Acoustique*, 7. *pp.* 39–72, *Jan.–March*, 1938.—Conclusion of critical analysis of papers published in 1935–6. [See Abstract 3333 (1938).]

**4609. Total Reflection of Supersonic Waves. S. I. Kretschmer and S. N. Rschevkin.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 20. 1. *pp.* 17–20, 1938. *In English.*—It is recalled that in the case of total reflection of a sound wave at the boundary of two media, partial penetration of the sound into the second medium takes place. The nature of the waves in the second medium is discussed mathematically and it is concluded that waves travel parallel to the surface of separation, decreasing in amplitude as distance from this surface is increased. The more the angle of incidence exceeds the critical angle the more rapidly the amplitude decreases with penetration into the second medium. Total reflection of supersonic waves at a vaseline oil-salt solution interface is studied experimentally, photographs being shown which confirm the above conclusions. K. M. C.

**4610. Diffraction of Light by Superposed Supersonic Waves. M. A. G. Rau.** *Indian Acad. Sci., Proc.* 8A. *pp.* 6–7, *July*, 1938.—Pictures are reproduced of the diffraction patterns obtained with light that has traversed a system of superposed supersonic waves set up in a liquid. Besides the presence of the combination lines, the pictures clearly show the characteristic manner in which their number and intensities depend upon the intensity of the original spectral orders. AUTHOR.

**4611. Diffraction of Light by Supersonic Waves. K. N. Rao.** *Indian Acad. Sci., Proc.* 8A. *pp.* 124–134, *Aug.*, 1938.—The results of Raman and Nath in their general theory of the diffraction light by supersonic waves at normal and oblique incidences are shown to be in complete agreement with those of van Cittert for the case of normal incidence [see Abstract 4128 (1937)] and also with those obtained by extending van Cittert's method to the case of oblique incidence. The amplitude function for the latter case is developed *in extenso* in a series of Bessel functions. The expression for the intensity with normal incidence in the case of N systems of sound waves is $|J_{n1}(\sigma_1 z)\, J_{n2}(\sigma_2 z) \ldots J_{nN}(\sigma_N z)|^2$,

where $n_1$, $n_2$, . . . $n_N$ are the orders excited. This result is the same as that which has been obtained by E. Fues by applying the simplified Raman-Nath method to the case considered. AUTHOR.

*4612. **Circuit Details for a Small Supersonic Oscillator of the Piezoelectric Type. W. C. Bosch and W. G. Allée, Jr.** *Am. Phys. Teacher*, 6. *pp.* 272–273, *Oct.*, 1938.—A compact 220-kc. supersonic oscillator, using two 250-W triodes in a self-rectifying parallel-feed Hartley circuit, is described and circuit constants are given. The quartz crystal is immersed in transformer oil and the mound, 4 to 5 cm. high, raised on the oil surface at maximum power output indicates that sufficient supersonic energy is available for many experimental uses. AUTHORS.

**4613. Measurement of Absorption in Rooms with Sound Absorbing Ceilings. J. R. Power.** *Acoustical Soc. of America, J.* 10. *pp.* 98–101, *Oct.*, 1938.—Serious difficulties have been encountered in attempts to measure the absorption coefficients of sound absorbing ceilings in large offices. An analysis of the sound field is made and it is concluded (1) that the reverberation time formula is usually invalid if the absorption is concentrated on one surface of the room, (2) that the energy density formula is not subject to such a restriction and (3) that under such conditions there is no apparent field method of determining the absorption coefficient that will serve as an accurate check on laboratory measurements. AUTHOR.

**4614. Hearing during Noise. Physiological Effect. Y. Rocard.** *Rev. d'Acoustique*, 7. *pp.* 37–38, *Jan.–March*, 1938.—When speech is transmitted while noise is present, the loudness of speech required for clearness of hearing increases with the loudness of the noise in such a way that when these are plotted against each other the curves of equal distinctness approach each other for high values of loudness. G. E. A.

**4615. Noise Measurements aboard Ship. H. A. Simms.** *Engineer*, 166. *pp.* 345–346, *Sept.* 23, 1938. *Paper read before the Am. Soc. Naval Engin.*—The procedure employed by the U.S. Naval Engineering Experiment Station in making noise measurements on board ship is described and explained. In enclosed spaces readings are taken with the microphone in a number of different positions in order to eliminate the effects of stationary waves. The importance of proper frequency weighting networks in total noise measurements is pointed out. K. M. C.

**4616. Absorption of Sound in $CO_2$ and Other Gases. V. O. Knudsen and E. F. Fricke.** *Acoustical Soc. of America, J.* 10. *pp.* 89–97, *Oct.*, 1938.—Sound absorption measurements in pure $CO_2$ at 1 atm. and 22° C. have been conducted which, together with measurements by others, confirm the collision theory of anomalous absorption as developed by Einstein, Kneser and others. The absorption coefficient is appreciable at frequencies as low as 2000 ~, and increases to a maximum of 0·317 per wave-length at 77,000 ~. This maximum is higher than values obtained by previous workers, and indicates that both the deformation and symmetrical valence vibrations participate in the exchanges between translational and vibrational energy. Small impurities, as water or alcohol vapours, affect the absorption greatly; the entire absorption band is shifted to higher frequencies. Measurements in mixtures of $CO_2$ in $O_2$ and $CO_2$ in $N_2$ indicate that neither the $O_2$ nor $N_2$ is appreciably excited by collisions with $CO_2$. Measurements in $CS_2$ reveal an absorption similar to that for $CO_2$ except that the absorption begins at about 10,000 ~.

In mixtures of $CS_2$ and $O_2$, the observed absorption at frequencies below 10,000 $\sim$ is accounted for by assuming that only the vibration of $O_2$ molecules is excited by collisions with $CS_2$ molecules; at higher frequencies the $CS_2$ molecules also are excited, principally by collisions with other $CS_2$ molecules. AUTHORS.

***4617. Absolute Sound Measurements in Liquids. E. Klein.** *Acoustical Soc. of America, J.* 10. *pp.* 105–111, *Oct.*, 1938.—The fundamental problem of absolute sound measurements in liquids is discussed. Regarding acoustic determinations, reference is made to certain inherent differences between air and water. An outline is presented of three methods now available for sound determination. A modified radiation pressure apparatus is described which permits a dual check of the basic measurements involved, and at the same time makes possible microphone calibration for secondary standards. [See also Abstract 2107 (1938).] AUTHOR.

***4618. Adjustable Tuning-Fork Frequency Standard. O. H. Schuck.** *Acoustical Soc. of America, J.* 10. *pp.* 119–127, *Oct.*, 1938.—A portable tertiary frequency standard, adjustable over a small range, is described. The frequency determining element is a tube-maintained tuning fork, adjustment of whose frequency over a relatively small range is accomplished by changing the position of movable weights on the prongs. Calculations are simplified by the design of the fork, which permits the assumption of lumped constants. The weights may be moved while the fork is running without interfering with its operation. Indication of their position is by means of a pointer reading on a scale graduated directly in frequency units. A precise method of calibration is given. Mechanical arrangements are described for obtaining a uniformly spaced scale, and the possibility of using such a scale in correcting for the temperature coefficient of the fork material is discussed. The relative accuracy of such a fork is greater, the smaller the range of frequency adjustment. In the present development, adjustment may be made over a range of plus and minus 3% of the mean frequency, that is, a musical interval of one semitone, or 100 cents total change. Incorporation of this fork in the chromatic stroboscope has resulted in considerable simplification as well as an increase in the reliability of the instrument. AUTHOR.

*See also* Abstracts **4330**, **4575**, **4585**, and
3258B. Experiments on Supersonic Radiation. A. Giacomini.

# ELECTRICITY AND MAGNETISM.

## ALTERNATING-CURRENT NETWORKS.

**4619. Effects of Stray Admittances in Four-Arm Bridge Networks. N. F. Astbury.** *Phil. Mag.* 26. *pp.* 507–519, *Oct.*, 1938.—When one or more of the arms of a bridge consists of two or more components in series, the stray admittances between the junctions of these components affect the conditions of balance. Two fundamental results are obtained, referring to cross admittances between junctions in adjacent arms and in opposite arms. It is shown that in general the equations of balance are unsymmetrical, and that in consequence the presence of such admittances is shown by a change in balance point when the components in any one arm

are interchanged. For certain cases of circuit symmetry the effects vanish. The lack of symmetry distinguishes the effects from those arising from capacitances to earth. The application of the results to certain practical cases is considered, and suggestions as to treatment by circuit arrangement and by screening are made. AUTHOR.

**4620. Effect of Condenser Leads in Lecher Wire Measurements. H. Slätis.** *Ann. d. Physik*, 32. 8. *pp.* 734–742, *Aug.*, 1938.—The Morton-Drude-Coolidge formula for the capacity K of a condenser located in a Lecher wire system between two bridges at distances $x_1$ and $x_2$ is modified by consideration of the effect of the condenser leads. It thus becomes:

$$\frac{4\pi}{\lambda^1}\left[\mathrm{K}+\frac{\delta}{2\log d/\mathrm{R}}\right]\log d/\mathrm{R}=\cot\frac{\pi\,(x_1-\delta)}{\lambda^1}+\cot\frac{\pi(x_2-\delta)}{\lambda^1},$$

where $\lambda^1$ is the half-wave-length of the oscillations, $d$ and R the distance apart and the radius of the Lecher wires and $\delta=\mathrm{L}_{12}^2/(\mathrm{L}_{22}.4\log d/\mathrm{R})$. $\delta$ is an expression which takes account of the eddy currents induced in the condenser lead wires, $\mathrm{L}_{22}$ being the self-induction coefficient of the eddy current path in one lead wire and $\mathrm{L}_{12}$ the mutual-induction coefficient of this path and the corresponding Lecher wire. A. W.

***4621. Electronic Null Detector for Impedance Bridges. H. W. Lamson.** *Rev. Sci. Instruments*, 9. *pp.* 272–275, *Sept.*, 1938.—A kathode-ray tube containing two perpendicular pairs of electrostatic plates is utilised as a simple detector of balance in a.c. bridge networks. The pair which produce the horizontal or sweep motion of the spot across the screen are energised by the same generator which energises the bridge. The output from the detector terminals of the bridge is provided with a sufficient amount of amplification and then applied to the vertical deflecting plates. Suitable equipment is provided for varying at will the phase relation between the sweeping e.m.f. and the out-of-balance e.m.f. of the bridge. The figure traced on the screen of the tube is, in general, an ellipse and by proper choice of the phase relationship independent indications of the progress towards balance of the adjustments of the two components of the impedance are provided. Thus, as one example, the quadrature control is made to tilt the ellipse while the direct control closes it into a straight line. The direction of the tilt indicates whether the control is off balance in a positive or a negative direction. With this detector balance is reached with no more than two adjustments of the controls. The detector is not damaged by overloading, which merely produces a distorted ellipse in the initial stages. T. I. J.

*See also* Abstract 4644.

## CONDUCTION AND DISCHARGE IN GASES.

**4622. Wall Potential in the Diffusion Column. W. Funk and R. Seeliger.** *Zeits. f. Physik*, 110. 3–4. *pp.* 271–276, 1938.—A modification is introduced into the Schottky theory of the diffusion column. In this theory the electron concentration at the tube wall is set at zero and this leads to an infinite value for the wall potential. The boundary condition introduced is that the wall electron current is equal to the unrectified electron current. This theory is worked out in detail and it is shown that a finite value of the wall potential is obtained, leading to reasonable values for the thermal inhomogeneity of the column. [See also Abstract 759 (1934).] J. E. R.

**4623. Luminous Appearances and Sinusoidal Electric Oscillations of the Flash Discharge. R. Ricamo.** *N. Cimento*, 15. *pp.* 149–157, *March*, 1938.—In a previous communication experiments on a type of flash discharge which shows the " Raumsäule " (positive column), and the conditions for the production of such a discharge were described. The properties of this type of discharge are studied. Sinusoidal electric oscillations of high acoustic frequency are generated and are investigated with a kathode-ray oscillograph. C. J. B. C.

**4624. Glow Discharge Relation. Y. Kasiwagi.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 568–585, *July*, 1938. *In English.*—Recent experiments on the glow discharge in $N_2$ indicate a simple relation [see Abstract 2967 (1938)]. From measurements made for all possible combinations of 11 kinds of metallic electrodes, the terms of this relation are interpreted, and, by applying to the relation the generalised form of Aston's empirical equation, a meaning is found for the set of curves representing the relation between the current density and the vertex distance. From the relation and the data obtained, simple interpretations are proposed and discussed for sputtering, for the Crookes dark space, and for the appearance of the dark space and negative glow. N. M. B.

**4625. Excess Temperatures in the Glow Discharge. H. Fischer.** *Zeits. f. Physik*, 110. 3–4. *pp.* 197–213, 1938.—It is shown that considerable local excess temperatures exist in the glow discharge. The effects of these super-temperatures in a discharge in He at various pressures, on the characteristic quantities of the discharge, have been investigated and determined. The magnitudes considered are the current density, the kathode fall and the length of the discharge space. From the variations of these quantities a statement is made on the ionic mobilities and the dependence of the $\gamma$-coefficient on the ionic velocity $v^+$. In the discharge in He it was found that $v^+ > b^4 \cdot E$. In no case did the $\sqrt{E}$ law hold. An increase of $\gamma$ with the ionic velocity could not be determined. The correctness of the temperature determinations and corrections were tested experimentally. G. O. B.

**4626. Impulse Transference in Ionisation by Canal Rays. R. Koops.** *Ann. d. Physik*, 33. 1. *pp.* 57–69, *Aug.*, 1938.—The total ionisation in $H_2$ and $D_2$ produced by H and D canal rays is measured and found always to be greater in $D_2$ than in $H_2$. The difference in ionisation is measured for different canal-ray energies and expressed as a percentage of the total ionisation. Down to 2000 eV the absolute difference in total ionisation is constant. It is calculated how much more energy is required in $H_2$ than in $D_2$ to form the same numbers of pairs of ions in each gas ; this excess energy is constant down to 2000 eV and amounts to 250 eV for ionisation by H canal rays and 300 eV for D canal rays. From these observations and calculations it is concluded that in the ranges 2000 to 17500 eV for H canal rays and 2,200 to 8000 eV for D canal rays at the most $2 \times 10^{-4}$ of the energy calculated from the collision laws can be transferred to the atom. It follows further that the energy balance for collisions in $H_2$ and $D_2$ can only be different for collisions below 2000 eV. Such a difference can only be due to a difference in mass of the colliding particles and is thus an impulse transference. From comparison of the ionisation by H and D canal rays it must be assumed that the collisions in which there is an impulsive transfer take place against the whole molecule. J. E. K.

**4627. Formation of Negative Ions at Metal Surfaces. R. A. Smith.** *Roy. Soc., Proc.* 168*A*. *pp.* 19–42, *Oct.* 10, 1938.—Various processes of formation of negative ions at metal surfaces, and the conditions under which they may take place are discussed. Detailed calculations are given for the conversion of $Hg^+$ ions into $Hg^-$ ions at a Ni surface. The positive ions are assumed to be neutralised by capturing an electron from the metal, and to form excited atoms which subsequently capture another electron on falling into their ground state. This process is shown to account for the experimental results of Arnot and Milligan [see Abstract 4820 (1936)]. The calculated probability of formation by this process is $1{\cdot}4 \times 10^{-3}$ for 200 V $Hg^+$ ions striking a Ni surface normally. The process of simultaneous capture of two electrons from the metal is shown to be improbable. A negative ion formed near a metal surface for which the work function is greater than the electron affinity of the corresponding atom or molecule will have a considerable chance of being neutralised through one of its electrons passing into an unoccupied level in the metal. It follows that slow positive ions or metastable atoms will be ineffective as a source of negative ions. The formation of atomic negative ions from molecular positive ions is discussed. Calculations for the formation of $H^-$ ions from $H_2^+$ ions and from protons are given. The value obtained for the probability of formation of $H^-$ ions from 140 V protons striking a surface with work function less than 3·37 eV is about $4 \times 10^{-3}$. It is shown that $H^-$ ions will not be formed from protons at a surface with work function greater than 3·37 eV unless simultaneous capture of two electrons takes place. For formation of $H^-$ ions from $H_2^+$ the observed probability is only $1{\cdot}04 \times 10^{-5}$ for 200 V $H_2^+$ ions striking a Ni surface [see Abstract 836 (1937)]. This low value is shown to be due to the small probability of formation of the intermediate excited H atoms by dissociation of the incident ions. Clearly further experiments, using separated beams of protons and $H_2^+$ ions, are required in order to clarify the processes taking place when atomic negative ions are formed from molecular positive ions.

AUTHORS.

**4628. New Process of Negative-Ion Formation. Part IV. F. L. Arnot and C. Beckett.** *Roy. Soc., Proc.* 168*A*. *pp.* 103–122, *Oct.* 10, 1938.—In Parts I–III [see Abstract 836 (1937)] a new process of negative-ion formation was described. This process is the formation of negative ions at metal surfaces by bombardment of the surface with positive ions, the negative ion being formed by the positive ion capturing two electrons from the surface. The present paper shows that a new modification of this process can also occur. The experimental results show that a spectrum of negative ions is obtained when a surface is bombarded with positive ions of A or N or Hg, and that practically identical negative ion curves over the range of mass numbers from 10 to 54 are obtained by each type of positive ion. The negative ions observed have mass numbers 12, 16, 24, 29, 32, 38, 44 and 51. It is concluded that these negative ions arise from atoms and molecules of gas vapour adsorbed on the surface. It thus appears that there are two processes leading to the formation of negative ions at surfaces. The initial stage in each process is the same; this is capture of an electron from the surface by the incident positive ion into an excited state of the atom, probably by a resonance process. This excited atom, on reverting to its normal state, may then capture a second electron from the surface, again probably by a resonance process, so forming a negative ion of the same element as the incident positive ion.

The second process consists in the excited atom transferring by a collision of the second kind its excitation energy to an adsorbed atom on the surface, which then captures an electron from the surface, and so a negative ion of an element different from that of the incident positive ion is produced. The previous results are reviewed in the light of this new work which shows that no negative ions of N are formed. Certain alterations in the interpretation of the $CO_2$ results must also be made. The previous work on the formation of negative ions of Hg, H and O requires no amendment, except that the probabilities of formation of these ions may have to be raised. It is shown that no $O^-_2$ ions are formed at the surface of an oxidised W filament, but that they readily appear when the filament is cleaned by flashing. It is suggested that this effect is due to the increased work function of the filament when oxidised. It is also found that a covering of $O_2$ on the filament suppresses the peaks of mass numbers 24 and 38.

AUTHORS.

**4629. Formation of Negative Ions by Positive-Ion Impact on Surfaces. R. H. Sloane and R. Press.** *Roy. Soc., Proc.* 168*A*. *pp.* 284–301, *Oct.* 25, 1938.—It has been found that when a hot-kathode discharge is passed through Hg vapour, light negative ions are produced from surfaces exposed to positive-ion bombardment. The negative ions include some with energies greater than could be imparted to them in the existing electric fields. Experiments are described which eliminate the possibility that the excess energies could be produced through electrical oscillations. The conditions under which the negative ions appear indicate that they are produced mainly through sputtering of occluded electronegative films under the action of Hg positive-ion bombardment, but data from experiments of this type cannot be interpreted unambiguously. The existence of this process has been shown directly by a double mass spectrograph in which beams of positive ions of known kind are allowed to impinge normally on a metal disc in high vacuum and are found to produce a spectrum of negative ions, with properties similar to those of the negative ions obtained in previous experiments [*Nature*, 141. *p.* 872, *May* 14, 1938]. The existence of $Hg^-$ as a stable entity seems to be still in doubt. AUTHORS.

**4630. Dissociation of $O_2$ and Formation of $O_3$ in the Silent Electric Discharge. R. Krishnan and S. K. K. Jatkar.** *Indian Inst. of Science, J.* 21*A*. 20. *pp.* 223–236, 1938.—The authors have investigated the reaction in the Siemens ozoniser under static conditions and the equilibrium has been studied from the standpoint of the application of the law of mass action. Equilibrium was attained from one side only, using different initial pressures and different exciting voltages. At higher pressures there was a gradual approach to equilibrium when the exciting voltage was low. At lower pressures, there was a rise in pressure apparently due to the dissociation of $O_2$ into O atoms. When the exciting potentials were increased the equilibrium was reached in a shorter time and the dissociation of $O_2$ was observed at a higher pressure of $O_2$ than in experiments at a low exciting voltage. The $O_3$ produced is never proportional to ionisation as the quantity of $O_3$ formed is not at all related to the current flowing. Instead of assuming that a large number of secondary ions are produced by shock excitation and that these ions do not reach the electrode even under saturating conditions, it is much simpler to assume that dissociation of $O_2$ occurs under the effect of silent electric discharge and that the atomic O combines with the excited $O_2$ molecule

to form $O_3$. The equilibrium constant is calculated for the two reactions $O_2^* \rightleftharpoons 2O$ and $O_2^* + O \rightleftharpoons O_3$, which occur simultaneously. The constants are fairly concordant and well within the experimental error.

AUTHORS.

*See also* Abstracts 4450, 4461, 4515, 4517, 4635, and
3171B. Arc Discharge in Magnetic Field. S. Fukuda and S. Hoh.
3172B. A.C. Spark between Large Electrodes. Y. Ishiguro and V. Gosho.
3174B. Glow Voltage Curves for Noble Gases. H. Klemperer.

## CONDUCTION IN SOLIDS AND LIQUIDS.

***4631. Push-Pull-Stabilised Triode Voltmeter. C. Williamson and J. Nagy.** *Rev. Sci. Instruments*, 9. *pp.* 270–272, *Sept.*, 1938.—This general purpose, balanced triode voltmeter is stabilised by adjusting shunt resistors until the effective values of $\mu$ and $I_p$ are the same for both tubes. Built-in testing equipment is provided. The electrical zero of the galvanometer is unaffected by changes of $\pm$ 20% in power-supply voltage when the circuit has a d.c. sensitivity of 40,000 mm./V. The valves need not be specially selected. The balancing principle may be adapted for use in any circuit requiring matched valves. AUTHORS.

**4632. Null Method for Measuring E.M.F. with a Ballistic Galvanometer and Condensers. A. W. Smith.** *Am. Phys. Teacher*, 6. *pp.* 263–264, *Oct.*, 1938.—An unknown e.m.f. can be compared with the standard e.m.f. by using them to charge two condensers. The positive and negative charges in these condensers are allowed to mix, and the remainder is discharged through a ballistic galvanometer. This is a null method if one of the capacitances can be varied to give equal charges in the two condensers. A megohm, more or less, in series with the unknown e.m.f. does not decrease the accuracy of measurement. Several uncertainties are eliminated by using this as a substitution method. AUTHOR.

***4633. Characteristic Constants of the Moving-Coil Galvanometer and their Determination from the Periodic Proper Motion. L. Merz.** *Zeits. f. Instrumentenk.* 58. *pp.* 324–331, *Aug.*, 1938.—It is shown that the constants determining the performance of a moving-coil galvanometer can all be determined without difficulty with the exception of the effective turning couple. The latter quantity can be found by studying the oscillations of the moving system with different resistances in the external circuit. An error limit of 2% is obtainable. W. S. S.

***4634. Direct-Voltage Amplifier. E. L. E. Wheatcroft.** *Journ. Sci. Instruments*, 15. *pp.* 333–336, *Oct.*, 1938.—A mains-operated amplifier is described having an amplification ratio of about 600 and suitable for all frequencies from zero to 10,000 $\sim$. The full scale input is 100 mV and the input current is less than $10^{-9}$ A. The instrument employs standard receiving valves and is compensated to give a steady reading with normal variations of mains voltage. AUTHOR.

***4635. Dual-Range Potential Source for Field Use with Electroscopes and Geiger-Müller Counters. W. C. Bosch.** *Rev. Sci. Instruments*, 9. *pp.* 308–309, *Oct.*, 1938.—The battery-powered, portable potential source described utilises a hand-cranked condenser-type d.c. multiplier to keep an output condenser charged to a potential constant within 1%. A potentiometer and switching arrangement in the input circuit make available two output ranges of approximate values 0 to 0·43 kV and 0·65 to 1·08 kV. The unit is carefully insulated and operates efficiently under all conditions of humidity. AUTHOR.

**4636. Streaming Potentials and Surface Conductivity. A. J. Rutgers, E. Verlende and M. Moorkens.** *K. Akad. Amsterdam, Proc.* 41. 7. *pp.* 763–775, 1938. *In German.*—The abnormal form of the curves of $\zeta$ against $c$ for KCl is considered to be due to the influence of surface conductivity. Equations are developed which require the determination of the true $\zeta$-potentials, and the surface conductivity to be calculated from measurements on two capillaries, and from measurements on three capillaries to prove the correctness of the method of treatment. The apparatus used, the method of obtaining constant pressure, the measurement of electrical conductivity with the immersion electrodes, under exclusion of the atmosphere, are described. The results, obtained with capillaries made of Jena 16 glass, are given for KCl and $BaCl_2$. The theory is supported by the experimental results. F. J. B.

**4637. Electronic Conduction due to 4*f*-Electrons in Trivalent Rare-Earth Compounds. K. Ghosh and B. Ghosh.** *Indian Journ. Phys.* 12. *pp.* 259-270, *Aug.*, 1938.—The conductivity of fluorides of La, Ce, Pr, and Nd in the form of fine crystals has been measured by compressing them to the form of solid rings placed between two co-axial cylindrical electrodes. Taking lanthanum fluoride as standard and subtracting the conductivity of lanthanum fluoride from those of other fluorides, the contribution to conductivity due to 4*f*-electrons has been determined. Using a formula similar to that of Wilson for semiconductors, it is found that $\Delta W$ calculated from the measurements agrees approximately with the over-all width of the multiplet structure of the free ions of these elements as obtained from magnetic and spectroscopic data. Authors.

**4638. Atomic Resistance Increase of Dilute Lead Alloys between 273° and 14° K. A. Eucken and H. Schürenberg.** *Ann. d. Physik*, 33. 1. *pp.* 1–20, *Aug.*, 1938.—The increase in resistance of Pb due to the addition of 1% (atomic) of Mg, Ag, Cd, In, Sn, Sb, Hg, Tl and Bi respectively is determined from observations of the resistance ratios, $R_t/R_{273}$, of various percentages of these dilute binary alloys at temperatures between 273° and 14° K. The alloys are found to obey Norbury's rule, and the atomic increase in resistance also appears to be approximately proportional to the logarithm of the diffusion coefficient of the foreign element into Pb divided by the self-diffusion coefficient of Pb. At the lower temperatures considerable departures from Matthiessen's law are noticed. The upper solubility limits of Cd, Sb and Mg in Pb at normal temperatures are shown to be 0·65, 0·13 and 0·5% (atomic) respectively. R. W. P.

**4639. Electrical Conductivity and Phase Diagram of Ba Alloys with Bi, Mg, and Pb. G. Grube and A. Dietrich.** *Zeits. f. Elektrochem.* 44. *pp.* 755–767, *Oct.*, 1938.—Previous work [see Abstract 3809 (1938)] is extended to the systems Ba-Bi, Ba-Mg and Ba-Pb. Thermal analysis indicates the existence of the compounds $BaBi_3$ and $BaMg_9$. Two further phases in the Ba-Mg system probably have the formulæ $BaMg_4$ and $Ba_2Mg_5$. An apparatus is described in which the electrical resistance of solid and liquid alloys can be measured at temperatures up to 1000° C. This is used to investigate the system Ba-Pb over the whole concentration range and the results are embodied in a complete phase diagram. The compounds $BaPb_3$ and $Ba_2Pb$ melt without decomposition, while BaPb melts with decomposition and exists in two forms. The compound $Ba_2Pb$ forms mixed crystals with the components over a limited range. Small additions of Ba to pure Pb cause marked increases of hardness during "ageing" at room-temperature. L. A. W.

**4640. Conductivity Data of Aqueous Mixtures of $H_2O_2$ and $HNO_3$. W. H. Hatcher and D. W. MacLauchlan.** *Canad. J. of Research*, 16. *Sect. B. pp.* 253–259, *Aug.*, 1938.—Solutions of $H_2O_2$ and $HNO_3$ are unstable when the concentration of the latter is greater than 50%. The conductivities of $HNO_3$ solutions of concentrations lower than this value in water and water-peroxide mixtures have been determined, and the results indicate the formation of one or more unstable peroxides or peracids apparently incapable of ionising. AUTHORS.

**4641. H.F. Conductivity of Colloidal Electrolytes. G. Schmid and E. C. Larsen.** *Zeits f. Elektrochem.* 44. *pp.* 651–658; *Disc.*, 658, *Sept.*, 1938.—Change over into the colloid state is characterised by a marked drop in conductivity, osmotic pressure, activity, etc. From the chemical standpoint of McBain and Lottermoser this is attributed to prevention of dissociation, by formation of neutral colloids; from the electrostatic standpoint of Hartley and Pauli, to the action of interionic forces as a result of the formation of highly charged colloid ion micelles. Conductivity measurements at $\lambda=12$ and 20 m., on solutions of Na duodecylsulphonate, cetylpyridine chloride, Na oleate, K and Ca arabinates show a sharp increase of conductivity at high frequency. [See also Abstract 312 (1938).] The persistence of these substances as strong electrolytes right into the colloidal region must therefore be postulated, in opposition to classical chemical theory. D. R. H.

**4642. Passage of Electrons through Thin Films of Insulators. H. Klarmann and J. Mühlenpfordt.** *Zeits. f. Elektrochem.* 44. *pp.* 603–606; *Disc.*, 606, *Sept.*, 1938.—The conductivities of thin films of organic and inorganic insulators are studied in a direction at right angles to the surface. The former include phenolic resins, shellacs and varnishes in thicknesses of from 1 to 2 $\mu$, and the latter comprise films of $B_2O_3$, $CaF_2$ and $SiO_2$, reproducible results being obtained for $SiO_2$ in thicknesses of $0{\cdot}1$ to $0{\cdot}2$ $\mu$ but not for the other two inorganic films. In each instance the films are formed on a plate of polished Ag, and this serves as one electrode. At times an evaporated film of Ag formed the other electrode, but tin-foil, Hg and $CuSO_4$ solutions are also used. The nature of this second electrode is found to affect the results obtained for the lacquers. These organic films have a resistance which increases with the applied voltage whereas the resistance of the $SiO_2$ film is much greater, and decreases as the voltage is increased. The conductivity of the $SiO_2$ is attributed to cold electronic emission, and the lacquer films are shown to contain holes through which metallic electrons pass. R. W. P.

**4643. Electrical Conduction in Quartz, Periclase, and Corundum at Low Field Strength. E. G. Rochow.** *J. of Applied Physics*, 9. *pp.* 664–669, *Oct.*, 1938.—A method has been devised for measuring the electrical conductivity of single crystals at elevated temperatures and at field strengths below 3 V/mm. The conductivities of single crystals of quartz, periclase, and corundum have been measured by this method over a temperature range of 600° to 1400° C., in equilibrium with air. The increase of conductivity with temperature follows a single exponential relation in all cases, throughout the temperature range covered. Experimental curves and interpolated values are given. AUTHOR.

***4644. Trends of Instrument Design. C. C. Mason.** *Journ. Sci. Instruments*, 15. *pp.* 323–333, *Oct.*, 1938.—The expansion in the use of electricity demands measuring instruments of greater accuracy and covering wider fields. Measurements of physical or chemical changes

are often made by conversion of electrical variables capable of more convenient or accurate measurement, as for example in the measurement of temperature, pH, and gas percentage by the katharometer method. The application of Wheatstone bridge or potentiometer circuits to the measurement of varying extension or thickness of the order of 0·0001 in., and a recording densimeter are described and illustrated. The development of oscillographs and other electrical measuring instruments is traced with particular reference to some problems in design inherent in high-speed recording. The principles of micro-recording on celluloid by means of an accurately formed stylus are described with application to the measurement of vibration, acceleration, extension and pressure. [See also *Engineering*, 146. *pp.* 317–320, *Sept.* 9, 1938. *Paper read before the British Assoc. Cambridge*, Aug., 1938.] AUTHOR.

*See also* Abstracts 4288, 4369, 4549, 4733.

## DIELECTRICS AND CAPACITANCE.

**4645. Dipole Moments of Molecules Containing Two Movable Dipoles. J. Y. Beach and D. P. Stevenson.** *J. Chem. Phys.* 6. *pp.* 635–638, *Oct.*, 1938.—The average dipole moment of a molecule containing two movable dipoles has been calculated as a function of temperature and restriction to internal rotation for three different potential functions. The potential functions used are: $(V_0/2)(\cos\phi+1)$, $(V_0/\pi)(\pi-\phi)$ and $V_0/\pi^2(\pi-\phi)^2$, where $V_0$ is the difference in potential energy between the *cis* and *trans* forms of the molecule and $\phi$ is the angle between the planes containing the dipoles and the axis of rotation. Values of the integral $\int_0^\pi \cos x \exp(-bx^2)dx$ are tabulated for values of $b$ ranging from 0 to 2 at intervals of 0·1. The dipole moments of *s*-dichloro-ethane, 1,2-bromo-chloro-ethane and *s*-dibromo-ethane as a function of temperature are used with the three potential functions to determine values of $V_0$. The values thus obtained are compared with the values obtained by other methods. AUTHORS.

**4646. Internal Rotation in Ethylene Chloride. J. Y. Beach and K. J. Palmer.** *J. Chem. Phys.* 6. *pp.* 639–644, *Oct.*, 1938.—The electron diffraction method of investigation has been used to determine the nature of the potential barrier restricting the rotation about the C-C single bond in ethylene chloride ($CH_2Cl$–$CH_2Cl$). Assuming that the shape of the barrier is given by a cosine function, the height of the barrier is between 5 kg.cal./mole and infinity. This potential barrier is compared with the barrier resulting from the exchange repulsions and the electrostatic repulsions of the two ends of the molecule. Eyring's method was used for calculating the exchange repulsions. The repulsions between the Cl atoms must be calculated differently from the repulsions between H and Cl atoms in order to obtain agreement between theory and experiment. Experiments were duplicated at Princeton and Pasadena. AUTHORS.

**4647. Dipole Moments of HCl and DCl. R. P. Bell and I. E. Coop.** *Faraday Soc., Trans.* 34. *pp.* 1209–1214, *Oct.*, 1938.—Polarisation measurements over a range of 230° show that the dipole moment of DCl gas is definitely greater than that of HCl. The difference amounts to $0·003 \times 10^{-18}$ or $0·007 \times 10^{-18}$, according to the method of calculation. The value of $\mu$ found for HCl is $1·08_4 \times 10^{-18}$. The difference found is consistent with the value calculated from the anharmonicity of the zero-point vibration and the "effective charge" derived from infra-red data.

From the sign of the observed difference it is concluded that the instantaneous dipole moment of HCl *decreases* with increasing internuclear distance in the neighbourhood of the equilibrium point. It is shown that the variation of the "effective charge" with internuclear distance is probably of minor importance in determining the isotope effect. AUTHORS.

**4648. Dielectric Properties of Some Organic Substances. G. R. Paranjpe and D. J. Davar.** *Indian Journ. Phys.* 12. *pp.* 283–288, *Aug.*, 1938.—The density, the refractive index and the dielectric constant are determined at room-temperature (30°C) for the solutions of oleic acid, linolic acid, triolein, triricinolein, and tristearin, in benzene. The dielectric constant is determined at 7,500 kc./sec. (40 m.) using the method of resonance and a valve-voltmeter. The refractive index is determined for Na lines. The polarisations and the electric moment of the substances are calculated from the Debye equation using the method of least squares. The electric moment is explained from the point of view of the chemical constitution and structure of the substances. The values obtained are: oleic acid 1·009, linolic acid 1·208; triolein 3·158, triricinolein 4·117 and tristearin 2·844. AUTHORS.

**4649. Dielectric Properties of Acetylenic Compounds. Part X. F. J. Krieger and H. H. Wenzke.** *Am. Chem. Soc., J.* 60. *pp.* 2115–2119, *Sept.*, 1938.—An apparatus has been constructed for measuring accurately the dielectric constants of gases and vapours at various pressures and temperatures. A method which obviates the necessity of equations of state is used in determining the polarisations of gases and vapours from their dielectric constants. The dielectric constants, polarisations and electric moments have been determined for gaseous methyl-, ethyl-, propyl-, butyl- and amyl-acetylenes. [For Part IX see Abstract 316 (1938).] AUTHORS.

**4650. Electric Polarisations of Metallic Acetylacetonates. A. E. Finn, G. C. Hampson, and L. E. Sutton.** *Chem. Soc., J. pp.* 1254–1263, *Sept.*, 1938.—Dipole measurements have been made on Be acetylacetonate in a variety of solvents, and between 298–415° K. in decalin. and on several metallic acetylacetonates in $C_6H_6$ solution. The data obtained in non-polar solvents show a large difference (approximately 45% $_E P_2$) between the mol. total polarisation $P_2$ and the mol. electron polarisation $_E P_2$ of the solute, which has second order dependence on the solvent, and which falls into one of three groups of rough ratio 2 : 3 : 4 as the compound contains 2, 3 or 4 chelate groups. The results may be due to (i) a transitory electric moment arising from slow bending within the molecule caused by thermal bombardment [see Hampson, Abstract 4318 (1934)], or (ii) to atom polarisation, in which the field induces considerable moments by causing inter-nuclear movements. The former is not probable, as calculations show that the frequency of bending would be too high for the molecule to orient while bent. [See following Abstract.] W. R. A.

**4651. Electric Moments of *p*-Benzoquinone and Related Compounds. D. L. Hammick, G. C. Hampson and G. I. Jenkins.** *Chem. Soc., J. pp.* 1263–1268, *Sept.*, 1938.—*p*-benzoquinone, its symmetrical dimethyl- and dichloro- derivatives, and 2 : 2 : 4 : 4-tetramethyl-*cyclo*butane-1 : 3-dione, with geometrically symmetrical molecules whose electric moments should be zero, are definitely polar, with an approximately constant difference between their total and electron polarisations. A mechanical model of the structure of *p*-benzoquinone shows that polarisa-

tion by bending is possible, but cannot be the primary cause. This is confirmed by calculation of the frequency of bending which does not agree with the infra-red absorption frequency. The polarisation discrepancies are therefore high atom polarisations or solvent effects. [See preceding and following Abstracts.] W. R. A.

**4652. Electric Polarisations of Substances having Anomalous Dipole Moments, and their Bearing on the Theory of Atom Polarisation. I. E. Coop and L. E. Sutton.** *Chem. Soc., J. pp.* 1269–1286, *Sept.*, 1938.—The electric polarisations of various acetylacetonates, symmetrical diketones, symmetrical di$NO_2$- and diCN- compounds, and tetrahalides in the vapour state have been measured over various ranges of temperature. The polarisations are temperature independent; and comparison with results obtained in solution (*loc. cit.*) show that the anomalous moments are not due to solvent effects. The compounds studied are non-polar in their unperturbed configurations, and can only become polar as a result of bending or twisting. The observed facts are therefore due either to slow thermal bendings (I) or to atom polarisation $P_A$. Calculation of the vibration frequencies, however, eliminates (I). Extending the theory of $P_A$, a relation is obtained between $P_A$, force constant of bending, and bond moment for a molecule, which has been tested quantitatively with success for a number of compounds; the series of diphenyl Hg compounds proves an exception. The polarisations of the diketones studied are explained by the hypothesis that each C=O bond bends relatively to the rest of the molecule and perpendicularly to the plane of the double bond. [See preceding Abstract.] W. R. A.

**4653. Dipole Moments of Aliphatic and Aromatic Aldehydes and of Anthrone. D. I. Coomber and J. R. Partington.** *Chem. Soc., J. pp.* 1444–1452, *Sept.*, 1938.—The dipole moments of a number of aldehydes have been measured. The moments of the lower aliphatic aldehydes are discussed from the point of view of the series effect. From the moments of benzaldehyde and its substituted derivatives an angle of 55° between the axis of the ring and the C=O direction is found. Allowance for interaction moment in the *p*-substituted compounds is made by a comparison with the corresponding acid chlorides, and by an application of these results a value of 125° is found for the angle between the axes of the rings in benzophenone. The —CHO groups in *p*-phthalaldehyde are found to exhibit completely free rotation. AUTHORS.

**4654. Frictional Dispersion of Dielectric Constants of Organic Liquids. E. Plötze.** *Ann. d. Physik*, 33. 3. *pp.* 226–242, *Oct.*, 1938.—Very full experimental details are given for measuring the frictional dispersion to a great degree of accuracy of the dielectric constants of organic liquids in dilute solutions. A contribution is also made to the problem of the quantitative evaluation of the respective dispersion curves, *e.g.* determination of such characteristic magnitudes as relaxation-times, molecular frictional coefficients, molecular diameters, and rotational hindering of polar molecules. The liquids were: Pure paraffin- and shell oils, nitrobenzene in paraffin and shell oils, amyl alcohol in shell oil, nitrobenzene in hydrorubber, chlorobenzene in hydrorubber, nitronaphthalene in shell oil. 14 sets of dispersion curves are included. H. H. Ho.

**4655. Dielectric Constant of Cellulose. H. A. De Luca, W. B. Campbell and O. Maass.** *Canad. J. of Research*, 16. *Sect. B. pp.* 273–288, *Aug.*, 1938.—A method has been devised for the measurement of

the dielectric constant of a material that cannot be made completely to fill a condenser. The following is the procedure adopted : Two completely miscible liquids are so chosen that the dielectric constant of the material under examination lies between the two values for the liquids. The dielectric constants of solutions of A and B ranging from 100% A to 100% B are measured. A curve is drawn showing the relation between dielectric constant and percentage composition. The condenser used is then partly filled with the fibrous material. The solutions of A and B are introduced into the condenser and the net dielectric constants are determined. A second curve is drawn showing this relation. The point of intersection of the two curves gives the composition of that liquid that has the same dielectric constant as the fibrous material. This method has been applied to the measurement of the dielectric constant of cellulose, benzene and ethylene dichloride being used. A value of 6·1 has been obtained for this constant. AUTHORS.

**4656. Electrical Breakdown of Alkali Halides. R. J. Seeger and E. Teller.** *Phys. Rev.* 54. *pp.* 515–519, *Oct.* 1, 1938.—A theoretical justification is given for the mechanism proposed by v. Hippel [see Abstract 729B (1938)] to account for the electrical breakdown of the alkali halides. Values of the breakdown field calculated on the basis of the theory are found to compare favourably with those obtained experimentally. A critical comparison is made with another explanation of the breakdown proposed by Fröhlich. [See Abstract 2785 (1937).] AUTHORS.

**4657. Dielectric Loss in Polar Materials. F. H. Müller.** *Ergeb. d. exakt. Naturwiss.* 17. *pp.* 164–228, 1938.—The Debye theory of dipole moments and its application to dielectric materials containing polar molecules are first dealt with in detail. An account follows of the various experimental methods for the measurement of dielectric loss. Finally recent experimental data on the dielectric properties of polar materials are reviewed, and a comparison is made between the observed dielectric behaviour of the materials and the behaviour as predicted by the Debye theory. E. R.

*See also* Abstracts 4307, 4330, 4351, 4620, and
3333B. Attenuation Coefficients in Dielectric Cables. A. G. Clavier and V. Altovsky.

## ELECTROCHEMISTRY.

**4658. Galvanic Cells with Formation of Alloys. V. A. Plotnikov and D. P. Zosimovich.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 20. 1. *pp.* 31–34, 1938. *In English.*—The authors report results obtained by short circuiting various cells, alloys being formed in this way by deposition of a base metal on a nobler one. In the cell $Zn/ZnSO_4$,aq/Cu, Zn potential remained at −0·79 V while the Cu potential altered from +0·22V to −0·70, approaching that of Zn, at 18°C. The cell $Zn/ZnCl_{2fused}/Cu$ at 380°±5°c. gave yellow $\alpha$ or $\beta$ alloys after 40 min. and grey $\gamma$ or $\xi$ alloys after 180min. on the surface of the Cu, the latter alloy having a thickness of 0·012 mm. Breaks in the e.m.f./time plot are conjectured to be due to different phases, and X-ray analysis shows a triplex structure, with lines of $\alpha$, $\beta$ and $\gamma$, in some cases. In the cell $Al/AlCl_{3fused}$-$NaCl_{fused}/Cu$, $\alpha$ Al-Cu alloys are similarly formed, recrystallisation of $\alpha$ occurring at 300°-350°c., with rising temperature and increasing proportion of $\gamma$ is formed. D. R. H.

***4659. Preparation of NaOH and $H_2SO_4$ by Electrolysis of $Na_2SO_4$. G. Grube and S. Stainoff.** *Zeits. f. Elektrochem.* 44. *pp.* 640–648,

*Sept.*, 1938.—Electrolytic cells for the preparation of both NaOH and $H_2SO_4$ by the electrolysis of $Na_2SO_4$ solution are described, including cells with horizontal diaphragms, cells with vertical filter diaphragms, and the mercury process. The efficiency of the various processes is discussed. A. J. M.

**4660. Calculation of the Ionisation Constants of Inorganic Oxygen Acids from their Structures. A. Kossiakoff and D. Harker.** *Am. Chem. Soc., J.* 60, *pp.* 2047–2055, *Sept.*, 1938.—The calculation of the ionisation constants of inorganic oxygen acids has been carried out on the basis of reasonable assumptions concerning the structures of the acid molecules and the mechanism of ionisation. Most of the calculated ionisation constants agree with the experimental ones to within a factor of 8. The free energy of ionisation has been shown to consist of a term depending only on the structure of the acid and a term depending only on the solvent and the temperature. The constant term has been evaluated from the ionisation constant of a single acid of known structure. The ionisation constants of a large number of acids have been evaluated, and have been found to agree well with experimental values. On the basis of the calculation the structures of a number of acids have been determined from their known strengths. The effect of resonance on the strength of acids is discussed. AUTHORS.

**4661. Observation of Diffusion Layer in Electrodeposition. H. J. Antweiler.** *Zeits. f. Elektrochem.* 44. *pp.* 719–724, *Oct.*, 1938.—Two experimental arrangements are described by which it is possible to render visible the diffusion layer at a Hg drop electrode during electrolysis. Both methods make use of the differences of refractive index which occur. The first method (the *schlieren* method of Toepler) is only applicable to solutions of concentration greater than $0{\cdot}1N$. The second method, in which an arrangement similar to a Jamin interferometer is used, can be applied for concentrations down to $0{\cdot}002N$. Both arrangements are so luminous that photographic exposures of 1/300 sec. can be made. Photographs are reproduced. L. A. W.

**4662. Coupling of Ionic Transference in the Case of Multiple Electrodes. K. Nagel.** *Zeits. f. Elektrochem.* 44. *pp.* 637–639, *Sept.*, 1938.—A graphical method of investigating the possible ionic transferences between two ionic phases is described. A. J. M.

**4663. Electrolytic Migration Velocity in Metallic Solutions. K. Schwarz.** *Zeits. f. Elektrochem.* 44. *pp.* 648–650; *Disc.*, 651, *Sept.*, 1938.—Apparatus is described for the determination of the velocity of ions in metallic solutions (dilute amalgams). The ionic velocity is of the same order of magnitude as in aqueous solutions, amounting to several cm./hr. for a potential gradient of 1 V/cm. A. J. M.

**4664. Elimination of Liquid-Junction Potentials. Part I. B. B. Owen. Part II. B. B. Owen and S. R. Brinkley, Jr.** *Am. Chem. Soc., J.* 60. *pp.* 2229–2239, *Sept.*, 1938.—A method of eliminating heterionic liquid-junction potentials was tested in cells with buffer solutions, and extrapolation from the numerical results so obtained. The junction extrapolation was found to be linear as a first approximation. The method was applied to the determination of the standard potential of the Ag electrode at 5,° 15,° 25,° 35°, and 45° C. By combination of the normal potentials of the Ag and Ag-Ag-halide electrodes, the solubility products and the solubilities of (electrolytic) AgCl, AgBr and AgI were computed from 5° to 45°C. F. J. B.

***4665. Reactions with Commutated D.C. at a Graphite Electrode. V. Sihvonen.** *Zeits. f. Elektrochem.* 44. *pp.* 659–662, *Sept.*, 1938.—A new three piece *H*-cell is described, and yields of $H_2$, $O_2$, $CO_2$, CO, $CH_2O$, $CH_2(OCH_3)_2$ under different conditions, with $H_2SO_4$, $Na_2SO_4$, and NaOH as electrolytes, are reported. $O_2$ appears to be more active than $H_2$. As a result of $H_2O$ formation oxidation of the graphite is slower in NaOH. Formaldehyde synthesis appears to depend on alternate oxidising and reducing conditions at the graphite surface as well as on porosity, and is almost absent in concentrated $H_2SO_4$. The various organic reactions necessary for production of an $\alpha$ diketone group are discussed. With too rapid commutation in acid electrolytes, there is practically quantitative production of $H_2O$. D. R. H.

***4666. New Polarograph and Applications. A. Schmidt.** *Zeits. f. Elektrochem.* 44. *pp.* 699–708, *Sept.*, 1938.—A description is given of an instrument which is an elaboration of the so-called polarograph of Heyrovsky and Shikata. Not only is an automatic photographic record of the current obtained, but the polarisation of the electrode under investigation is simultaneously recorded on the same paper. This is achieved by connecting the electrode to a normal electrode by means of a Luggin capillary and recording the e.m.f. of the resulting element by means of an amplifier and mirror galvanometer. A reversing device enables the polarographic records to be obtained both in rising and falling directions and the range can be extended past the zero point into the region of opposite sign. A device is also incorporated whereby measurements can be carried out at different velocities. In the second part of the paper an account is given of the application of the instrument to investigations of $H_2$- and metal electrodes. L. A. W.

**4667. Potential of Pt in Solutions of Ag Salts. A. Obrutschewa.** *Acta Physicochimica*, 8. 6. *pp.* 679–696, 1938. *In German.*—The variation of the potential of a Pt or Au electrode in solutions of Ag salts with time has been determined. The fall in the potential is shown to be due to the presence of small concentrations of $Ag_2$ ions in the solution. These first reduce the $O_2$ adsorbed on the metal, and finally deposit Ag on the electrode. The adsorption of Ag salts on platinised Pt was investigated and it was shown that this process is not responsible for the characteristic potential jump of the Ag electrode. The potential of Ag in $Cu(NO_3)_2$ solutions observed by Essin and Beklenyschewa can be quantitatively explained by the assumption that the reaction $Ag+Cu^{\cdot} \cdot \rightarrow Ag^{\cdot}+Cu^{\cdot}$ occurs. A. J. M.

*See also* Abstracts 4296, 4363, 4636, 4644.

## ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

**4668. Multiple Structure of the Electron. U. Kakinuma.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 818. *pp.* 991–1000, *Sept.*, 1938. *In English.*—A stationary electron has a multiple structure of spherical symmetry. The innermost core of radius $\sqrt{\kappa e}$, or $\sqrt{\gamma e}/C^2$ ($=10^{-30}$ cm.) contains the electronic mass and charge. The outer region extending from $e^2/2mc^2$ to infinity is the ordinary electromagnetic field in which the energy $mc^2$ is stored. The intermediate region has not yet been explored. The quantum mechanics deals with the state of these fields superposed altogether. The energy in the core is composed of two parts: the one is of the fixed value corresponding to the spin magnetic

energy, and the other is of a variable amount sharing the kinetic energy with which the electron describes a certain Bohr orbit. The spin angular momentum is identified with the intrinsic action of the electron, *viz.*, $h/2$. The corresponding magnetic moment is calculated classically, obtaining the correct value—$he/2mc$. AUTHOR.

**4669. Mass of the Neutron. G. Stetter and W. Jentschke.** *Zeits. f. Physik*, 110. 3–4. *pp.* 214–222, 1938.—By means of an ionisation chamber and a proportional amplifier the yield of protons, liberated from D by irradiation with the hard $\gamma$-radiation of ThC'' of $2{\cdot}623$ eMV energy, was measured as $6650 \pm 200$ El.Qu. The mean energy necessary for the production of ions in H by quite short H-rays has been accurately determined as $32{\cdot}6 \pm 1{\cdot}2$ eV. From this the binding energy of the deuteron is calculated to be $2{\cdot}189 \pm 0{\cdot}022$ eMV, and the mass of the neutron as $1{\cdot}00895 \pm 0{\cdot}00003$, using the present best mass-spectroscopic value. G. O. B.

**4670. Velocity Distribution of Elastically Colliding Electrons. R. Lichtenstein.** *Phys. Zeits.* 39. *pp.* 646–656, *Sept.* 15, 1938.—In a gas whose molecules have temperature motions there are electrons which make elastic impacts on the gas molecules. The velocity distribution of such electrons is calculated when they are subject to a homogeneous electric field. The electron density is assumed to be so small that the mutual effect of the charge carriers on one another can be neglected. From the electron balance in the velocity space simple expressions are derived for the distribution density, almost sphere-symmetrical, of the electrons in the velocity space. The data employed concerning the gas molecules are their mass and their so-called kinetic cross-section. The velocity distribution of the swift electrons is determined principally by the temperature motion of the gas molecules, which increases considerably the proportion of electrons rich in energy as compared with the case treated by Morse, Allis and Lamar, where the gas temperature was null [see Abstract 4383 (1935)]. A. W.

**4671. Scattering and Loss of Energy of Fast Electrons and Positrons in Lead. W. A. Fowler and J. Oppenheimer.** *Phys. Rev.* 54. *pp.* 320–324, *Sept.* 1, 1938.—A cloud-chamber investigation is made of the scattering and loss of energy in a thin lead lamina of fast electrons and positrons (5-17eMV) produced as secondaries by $\gamma$-radiation from $Li^7 + H^1$. Comparison of the experimental results of scattering with angle shows good agreement with the Rutherford-Mott theory at about $\theta = 13°$. Below this angle the behaviour is consistent with multiple scattering. Evidence is found for an excess scattering at large angles of electrons over positrons. The average loss of energy is found to be about $1{\cdot}5$ times the theoretical value. It does not seem possible to account completely for this excessive energy loss on the basis of a longer effective path in the lamina. No difference in the loss of energy of electrons and positrons is found. C. J. B. C.

**4672. Inelastic Scattering of Slow Electrons from a Silver Single Crystal. J. C. Turnbull and H. E. Farnsworth.** *Phys. Rev.* 54. *pp.* 509–514, *Oct.* 1, 1938.—The energy distribution of electrons inelastically scattered from a (111) face of an Ag single crystal has been studied by the method of magnetic deflection. At about 45° incidence primary electrons are regularly reflected in to the analyser, and diffraction beams are observed at primary energies of $7{\cdot}7$, $23{\cdot}2$, and $83{\cdot}2$ eV. The structure in the energy distribution shows two discrete loss peaks at

3·9 and 7·3 eV, respectively, in general agreement with that found by Rudberg for polycrystalline Ag. However, the relative intensities of the two discrete loss peaks depend on both the primary voltage and the target angle near the diffraction beams, while Rudberg has found that for polycrystalline targets the peaks are independent of these variables. The energy distribution curves are also distorted by an extra inelastic scattering which accompanies the elastic scattering of the diffraction beams, and which extends down to an energy loss of 10 to 15 eV. Thus, maxima are observed in the curves giving the amount of inelastic scattering as a function of the primary energy for the constant values of energy loss. The maxima occur at secondary energies equal to the critical voltages of the diffraction beams. This indicates the existence of a double process consisting of inelastic scattering of the incident electrons followed by diffraction of the scattered electrons by the crystal lattice. AUTHORS.

**4673. Scattering of Fast $\beta$-Particles by Mercury Nuclei. A. Barber and F. C. Champion.** *Roy. Soc., Proc.* 168*A*. *pp.* 159–167, *Oct.* 25, 1938.—The scattering of $\beta$-particles of about 1mV energy by Hg nuclei is examined with an expansion chamber for angles of scattering greater than 20°. The absolute number scattered is much less than would be expected from Mott's formula. There is also indication of more inelastic collisions than are predicted by the theory of Bethe and Heitler. Photographs are reproduced which show the sudden stoppage of a fast $\beta$-particle with the simultaneous production of what appear to be low energy pairs of positrons and electrons. It is suggested that the results may be qualitatively explained on the assumption of a repulsive field between electrons and nuclei for close distances of approach. AUTHORS.

**4674. Rutherford Scattering with Radiation. W. Braunbek and E. Weinmann.** *Zeits. f. Physik*, 110. 5–6. *pp.* 360–372, 1938.—A comparison of different formulæ obtained by Mott, Sommerfeld, Scherzer, Bethe and Heitler for the cross-section in nuclear scattering with radiation, which agree one with another, and the formula recently obtained by Bloch and Nordsieck [see Abstract 4026 (1937)] by a different method of approximation, shows that the earlier formulæ follow from the results of Bloch and Nordsieck when developed in a power series of $\alpha$, the Sommerfeld fine-structure constant, the linear term being omitted. It is thus quite clear why, in spite of this close connection between the results, the method of Bloch and Nordsieck avoids the so-called infra-red catastrophe, which was involved in the earlier formulæ. The avoidance of the infra-red difficulty permits calculation to be made of the correction which Rutherford's angular distribution requires when radiation is taken account of, though in this method there is some unavoidable uncertainty as to the upper limit of the frequency spectrum. The relative correction to the Rutherford formula taking radiation into account is found to be of the order of magnitude of $\alpha\beta^2$ and is therefore extraordinarily small. [See also Abstract 3400 (1932).] A. W.

**4675. Scattering of D-D Neutrons. S. Kikuchi and H. Aoki.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 808. *pp.* 865–872, *Aug.*, 1938. *In English.*—Investigations are described for the determination of collision cross-section measurements for 21 elements using monochromatic D-D neutrons of 2·4 eMV energy. Results are tabulated and plotted and are compared with those of other investigators. There is evidence that the cross-section is a regular function of the atomic number

and has a maximum and minimum. This cannot be settled until a larger number of elements is studied. N. M. B.

**4676. Neutron Resonance Levels of Ir and Rh. R. Jaeckel.** *Zeits. f. Physik*, 110. 5–6. *pp.* 330–333, 1938.—Continuing previous work [see Abstract 862 (1938)], it is shown from absorption experiments in Rh that the two activities with half-periods 19·5 hr. and 68 days, produced when Ir is bombarded with slow neutrons, cannot arise from one and the same resonance level. F. C. C.

***4677. Fast Neutrons. H. Reddemann.** *Zeits. f. Physik*, 110. 5–6. *pp.* 373–388, 1938.—A discharge tube is described which is suitable for the production of very fast corpuscular rays. With it an investigation has been carried out into the yield of neutrons on bombardment of D with D. The cross-section for the D-D reaction has also been obtained in the range 0·1 to 1·0 MV. G. O. B.

**4678. Action of Thermal Neutrons on Aluminium. P. Wang.** *Zeits. f. Physik*, 110. 7–8. *pp.* 502–511, 1938.—Al is bombarded by neutrons which have been slowed down in paraffin, and by absorption experiments with Cd adsorbers it is shown that the activity with a 2·3-min. period, which is due to neutron capture, is produced by thermal neutrons. Absorption measurements in Al give for the absorption coefficient the value 0·037 $cm^2$./gm., which is rather low and therefore suggests that there is no resonance level in the thermal region. Experiments are also made with an arrangement in which the specimen is surrounded by paraffin on all sides. A discussion is given of the more complicated geometrical factors arising in this case. R. P.

**4679. Equations of Motion of a Charged Particle in an Electromagnetic Field. T. Boggio.** *Comptes Rendus*, 207. *pp.* 134–136, *July* 11, 1938.—A charged particle moves in the field of $n$ magnetic poles situated on a straight line $l$ and an arbitrary electric field which is always coplanar with $l$. A first integral of the equations of motion is found. R. P.

**4680. Field Distribution and Graphical Ray Tracing in Electron Optical Systems. L. Jacob.** *Phil. Mag.* 26. *pp.* 570–601, *Oct.*, 1938.—The electrolytic trough method is applied to the case of an electron-optical lens system for mapping out its field distribution to an accuracy of 2–3%. The approximate electron trajectory for an electron entering the field in a direction parallel to the axis is calculated, using the axial potential distribution and its derivatives. Errors as large as 50% are introduced in this step-by-step process of approximation which restricts its usefulness. Use is made of the axial "geometric plot" to derive a simple method for the graphical construction of the ray-paths which gives a good approximation. The cases of widely spaced as well as closely spaced surfaces are separately considered. [See following Abstract.] AUTHOR.

**4681. Axial Potential Distribution in Electron-Optical Systems. L. Jacob.** *Phil. Mag.* 26. *pp.* 601–609, *Oct.*, 1938.—The calculation of the positions of the cardinal points of a lens system consisting of coaxial cylindrical electron lens components is briefly summarised. It is then shown that, in kathode-ray tubes, where the electron lens involves a more complicated form of field function, it is necessary to obtain an accurate field plot from which the first and higher derivatives are obtainable. A method, based on the use of Legendre polynomials, is devised for obtaining accurately the equation to the axial equipotential plot in terms of the distance along the axis from a fixed origin. An example is worked out to an

accuracy within 1% although the method is capable of yielding higher accuracy if desired. [See preceding Abstract.] H. J. H. S.

**4682. Focal Length and Image Quality of Circular Hole Lens with a Central Net. M. Knoll and H. Weichardt.** *Zeits. f. Physik*, 110. 3–4. *pp.* 233–236, 1938.—An accurate expression for the focal length of an electron lens consisting of two diaphragms with central apertures with a net placed midway between them is derived from the known approximate formula. The relative focal length for various dispositions of lens potential and dimensions is calculated and the results are expressed graphically. Some of the relations are verified experimentally.

H. J. H. S.

**4683. Focusing Properties of Electrostatic Field between Two Cylinders. F. H. Nicoll.** *Phys. Soc., Proc.* 50. *pp.* 888–898, *Nov.* 1, 1938.—A general survey of the focusing properties of an electron mirror formed by two cylinders has been made. Photographs of the images formed are shown, and the relations between object and image distances for different voltage ratios on the cylinders are obtained. A special case of multiple reflections is described. Some qualitative results relating to the behaviour of the two-cylinder lens at very high voltage ratios are given, and the formation of intermediate images in both lenses and mirrors is discussed. Finally, a qualitative description of the focusing properties of two cylinders for voltage ratios from $-\infty$ to $+\infty$ is given.

AUTHOR.

*See also* Abstracts **4270**, **4331**, **4376**, **4472**, **4519**, **4642**, **4644**, **4731**, and **3198B**. Inversion Spectrum of a Kathode-Ray Tube. H. E. Hollmann. **3200B**. Oscillograph with After Acceleration. A. Bigalke.

## ELECTROSTATICS.

**4684. Contact Potential. B. Gysae and S. Wagener.** *Zeits. f. Physik*, 110. 3–4. *pp.* 145–163, 1938.—For demarcation of the p.d.'s brought into being on the contact of two bodies, one of which is the contact potential, there is given an accurate definition for each of the actual touchings concerned and a clear indication of its nature is provided. The separate potentials referred to are : the galvanic potential, the contact potential, the discharge potential and the volta potential. For contact potential the relative defining equation is especially dealt with, and it is shown that the quantum theory deduction is the most general. For experimental illustration of the existence of the contact potential a tube is used by which, with a W wire as kathode the space discharge characteristic line, both towards a second W wire and towards a Ta wire as anode, can be measured. J. J. S.

***4685. Projection Electroscope for $\alpha$ and $\beta$-Rays. B. A. Spicer.** *Journ. Sci. Instruments*, 15. *pp.* 336–338, *Oct.*, 1938.—An instrument is described for the demonstration of some effects of $\alpha$- and $\beta$-rays. It is an electroscope in which the image of a gold-leaf is projected on to a screen for measurement or demonstration. AUTHOR.

***4686. Self-Exciting Electrostatic Generator with Charging Bands Situated in Compressed Gas. U. Neubert.** *Zeits. f. Physik*, 110. 5–6. *pp.* 334–351, 1938.—A description is given of the construction and operation of a self-exciting electrostatic generator with the charging bands situated in compressed gas. The supporting column is about 3 m. high and the charged sphere about 1 m. in dia. Of the different gases examined, compressed air was found to be the most generally satisfactory.

The potential obtained was determined with a simple resistance method based on Ohm's law and was found to be $7 \cdot 5 \times 10^5$ V in air and $9 \cdot 5 \times 10^5$ V in $CCl_4$ vapour. F. C. C.

*See also* Abstract 4635.

## GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

**4687. Thermomagnetic Longitudinal and Transversal Effect in Nickel. P. Wagner.** *Ann. d. Physik*, 32. 8. *pp.* 665–682, *Aug.*, 1938.—On the longitudinal and transversal magnetisation of a ferromagnetic wire, of which one part is above and the other below the Curie temperature, there occurs an e.m.f. The saturation value found for this e.m.f. by Broili [see Abstract 4598 (1932)] holds in all cases: $E_\infty = C(\Theta - T^2)$. The constant C depends in a high degree on the purity of the wire. The transversal e.m.f. and the longitudinal have opposite signs. Through lengthways extension the longitudinal e.m.f. may be increased to twice its value; the transversal e.m.f. may become 0. For an isotropic wire $C = -C_\perp$. It has not been explained why (analogously to the magnetic change of resistance) $C_\parallel$ is not twice as great as $C_\perp$. The e.m.f. shows hysteresis with very small remanence; with increasing stress the hysteresis disappears. In strong fields there occurs a decrease of the e.m.f. both longitudinal and transversal. In consequence the time magnetisation can be certainly ascertained. With small differences of temperature and stretched wire the e.m.f. is proportional to the square of the magnetisation: $E = \alpha\ (T) J^2$. The constant $\alpha(T)$ may be reduced to the constant $C_\infty$ (with great longitudinal stress). The following relation is strictly fulfilled: $\frac{\Delta E}{\Delta T} = \frac{2C_\infty J^2(T)}{J_\infty^2(T)}(\Theta - T)$. J. J. S.

## MAGNETISM AND ELECTROMAGNETISM.

**4688. Symmetries of the Magnetic Field. E. Brylinski.** *Comptes Rendus*, 207. *pp.* 136–138, *July* 11, 1938. **A. Cotton,** *ibid. pp.* 270–271, *July* 25, 1938.—The question whether a uniform magnetic field has mirror symmetry with respect to a plane at right angles to its axis or with respect to one through its axis depends on whether the field is described in terms of polar or axial vectors. R. P.

**4689. Electricity as a Fluid. G. D. Birkhoff.** *Frank. Inst., J.* 226. *pp.* 315–325, *Sept.*, 1938.—An outline is discussed of a two-fluid theory in some respects resembling Franklin's one-fluid theory, but allowing the free interpenetration of positive and negative electricity to produce a true neutral condition; gravitational effects may be omitted from consideration. A brief historical review is given of the progress of theory since Franklin's time, and it is suggested that a new conceptual outlook on theoretical physics may be based on a fuller exploitation of relativistic electrodynamics. The views discussed are built up in consonance with certain purely mathematical necessities on the one hand and qualitative physical considerations on the other. On various assumptions a mathematical specification of the constitutive equations for the electrified fluid in space-time is derived. N. M. B.

**4690. Magnetic Properties of Ni and Ni-Rich Alloys. T. Hirone.** *Tohoku Univ., Sci. Reports*, 27. *pp.* 101–114, *July*, 1938. *In English.*—Theoretical considerations on the line of the Bloch theory of ferromagnetism as well as the Slater theory of the electronic energy levels in metallic lattices are made on the change of magnetic properties

of Ni due to the addition of foreign metals making Ni-rich binary solid solutions. The present theory explains fairly well the manifold experimental results upon the magnetic characteristics of various kinds of the said binary solid solutions. AUTHOR.

**4691. Drift of Magnetic Permeability at Low Inductions after Demagnetisation. G. R. Patterson.** *J. of Applied Physics*, 9. *pp.* 646–653, *Oct.*, 1938.—Attempts at measurement of the magnetic properties of ferromagnetic materials at very low flux densities showed inconsistencies which were attributed either to errors in methods or to some behaviour of the material. Check tests, using the same procedure in each case, eliminated the first supposition. The results of this investigation show that, with a steel of medium Si content tested at 10 gauss over a period of 24 hr., there exists a 5 to 15% decrease in permeability. On the average, 50 to 60% of this drift occurred within 1 hr. after demagnetisation and none after 24 hr. AUTHOR.

**4692. Theory of Magnetic Neutral Solutions. New Possibility of Determining Magneton Values. O. v. Auwers.** *Zeits. f. Physik*, 110. 3–4. *pp.* 267–270, 1938.—Data obtained from the determination of magneton numbers of the ions of the transitional elements, using water as solvent, confirm the data of Salceanu [see Abstract 2175 (1938)], and indicate that it is possible by the method of magnetic neutral solutions to determine magneton numbers. W. R. A.

**4693. Magnetic Anisotropy and Pleochroism of Biotite Mica. P. Nilakantan.** *Indian Acad. Sci., Proc.* 8*A*. *pp.* 39–60, *July*, 1938.—The paramagnetic anisotropy and susceptibility of three biotites, one muscovite and one phlogopite were determined, also their ferrous and ferric contents and their pleochroism. The biotites are highly anisotropic, and the anisotropy and pleochroism increase with the iron content. The anisotropy depends on the ferrous iron only. The results are in agreement with the theory of the paramagnetism of solids developed by van Vleck and others, based on the splitting of the energy levels of the paramagnetic ion under the influence of the strong asymmetric crystalline electric fields. The pleochroism of biotite is discussed in the light of Saha's view that absorption of light in inorganic salts of elements of the transition series is due to transitions involving the reversal of the spin vector of one of the 3*d* electrons of the kation. G. E. A.

**4694. Transition Point of Magnetic Susceptibility of MnO. H. Bizette, C. F. Squire and B. Tsaï.** *Comptes Rendus*, 207. *pp.* 449–450, *Aug.* 29, 1938.—In similar fashion [see Abstract 3022 (1938)] the susceptibility of MnO was determined down to 10° K. Between 273° and 127° ($T_\lambda$) results agree with those of Tyler [see Abstract 5455 (1933)], but below that $\chi$ diminishes with temperature. Above $T_\lambda$ it is independent of strength of field, but increases therewith below that temperature. C. A. S.

**4695. Magnetic Properties of Anhydrous Nickel Chloride and the Laws of Variation of Paramagnetism. P. Laurent.** *J. de Physique et le Radium*, 9. *pp.* 331–336, *Aug.*, 1938.—The magnetisation of sublimed anhydrous $NiCl_2$ has been accurately determined between 15° and 450°. The coefficient of magnetisation, plotted as a function of the temperature, can show one of two forms depending on the previous thermal treatment of the sample. It may consist of two straight lines, a high temperature line characterised by a moment of 17·2 magnetons and a low temperature line of 16·4 magnetons, meeting near 250°; or the straight

line at low temperatures may continue as a curve above 250°. The curved region, which corresponds to a metastable state of $NiCl_2$, is attributed to the existence of several moments. W. R. A.

**4696. Magnetism and Molecular Constitution of Chromium Compounds. S. S. Bhatnagar, B. Prakash, and A. Hamid.** *Chem. Soc., J. pp.* 1428–1434, *Sept.*, 1938.—In the present work an attempt is made to define the structure of some Cr compounds from the magnetic standpoint. The susceptibilities of Cr ions in different valency states were calculated from the van Vleck, Sommerfeld, Bose, and Stoner formula, $\chi_M = N\beta^2[4s(s+1)]/3kt$, and compared with the experimental values determined on a modified form of Gouy's balance. Chromium dioxide is shown to contain quadrivalent chromium, the constitution of a complex chromium sulphate has been confirmed, and silver chromate and the pyridine salt of the so-called blue perchromic acid (since shown by Schwarz and Giese to be a derivative of $CrO_5$ and not $HCrO_5$) have been shown to contain sexavalent chromium. The supposed sexavalency of chromium in triamminochromium tetroxide and its quinquevalency in pyridinium tetrachlorohydroxychromate, $C_5H_5N.CrCl_4.OH,H_2O$, and the analogous quinolinium salt have been controverted, more satisfactory constitutions being suggested. The three isomerides of dichloroaquotriamminochromic chloride have been examined from the magnetic standpoint. Authors.

***4697. Magnetometer of Rogowski. G. Giorgi.** *Accad. Lincei, Atti*, 27. *pp.* 427–429, *May* 1, 1938.—Rogowski has proposed the measurement of the magnetomotive force $M$ acting along a line PQ in the following way: Construct a flexible solenoid of very small section and arrange it with its axis in the line proposed; if the line must traverse magnetic material substances let there be bored through them a tunnel of very small diameter along the selected direction; then measure the electromotive impulsion that is induced in the solenoid when the whole magnetic field is reversed in sign; then this impulsion comes out proportional to $M$, the value of which is sought. The boring of the tunnel is theoretical, in practice the magnetic materials dealt with are not traversed by currents (macroscopically) across their mass, and consequently it is possible to operate along a line which connects the extremities themselves and extends into the air. This arrangement in the hands of able experimenters gives results sufficiently good and can frequently be employed in practice. Some investigators such as Kupfmüller and others have gone further and have approached conceptually to employing the arrangement to *define* magnetomotive force. This suggestion interests the author as the proceeding described is a continuation of his own work. The magnetomotive force $M$ should not be defined as the integral of the lines of force H since the question then depends on H. The best direct definition, the author considers, is that related to energy, *i.e.* premises the notions of magnetic flux $\Phi$ and of magnetic induction $B$, arrived at electromagnetically and considered as a tube of flux having for axis the line PQ along which the value of $M$ is desired. Then let $\delta w$ be the elementary work which causes the increment of the flux by the amount $\delta\Phi$, and putting $\delta w = M/\delta\Phi$, $M$ is defined, and it is more easy to derive H from $M$ than *vice versa*. J. J. S.

***4698. Limiting Sensitivity of an A.C. Method of Measuring Small Magnetic Moments. E. A. Johnson.** *Rev. Sci. Instruments*, 9. *pp.* 263–266, *Sept.*, 1938.—A method of measuring the moment of small

magnetic dipoles is described. The dipole to be measured is rotated inside a fixed coil, and the voltage induced in the coil is measured by means of an a.c. amplifier. The limiting sensitivity is computed from the calculated signal-voltage and the thermal agitation in the input circuit. In the practical application the theoretical sensitivity is approximately obtained and moments of $3\times10^{-7}$ c.g.s. unit can be detected and with a specimen 1·5 cm. on a side $8\times10^{-8}$ c.g.s. unit/cm$^3$. can be detected. The method has been applied to the measurement of the polarisation in sedimentary deposits. AUTHOR.

**4699. Currents to Conductors Induced by a Moving Point Charge. W. Shockley.** *J. of Applied Physics*, 9. *pp.* 635–636, *Oct.*, 1938.—General expressions are derived for the currents which flow in the external circuit connecting a system of conductors when a point charge is moving among the conductors. The results are applied to obtain explicit expressions for several cases of practical interest. AUTHOR.

**4700. Change of Young's Modulus of Elasticity by Magnetisation in Iron and Carbon Steels. M. Yamamoto.** *Tohoku Univ., Sci. Reports*, 27. *pp.* 115–136, *July*, 1938. *In English.*—The change of Young's modulus of elasticity by magnetisation in annealed Armco iron and various carbon steels was measured by the method of magnetostrictive oscillation. Main results obtained are as follows: Young's modulus of elasticity in these materials increases by magnetisation, and the amount of increase is of the order of $10^{-3}$. The rate of increase is large in weak magnetic fields, and becomes gradually less as the field increases. For a given magnetic field, $\Delta E/E$ decreases continuously as carbon content increases. Akulov and Kondorsky's theory was confirmed for the total change of elasticity in Armco iron. AUTHOR.

**4701. Mechanical and Magnetic After-Effect in Carbonyl Fe. G. Richter.** *Ann. d. Physik*, 32. 8. *pp.* 683–700, *Aug.*, 1938.—A torsional after-effect is observed in carbonyl Fe which has the same temperature relation as the magnetic after-effect. In both cases the temperature effect is characterised by a Boltzmann factor $e^{-\theta/t}$ in which $\theta=10^4$. It is suggested that the two effects have a common origin which is briefly investigated. H. J. H. S.

*See also* Abstracts 4285, 4311, 4633, 4679.

## MEDICAL RADIOLOGY AND ELECTROLOGY.

***4702. Polyelectrophysiograph. O. L. Huddleston and R. W. Whitehead.** *Rev. Sci. Instruments*, 9. *pp.* 315–319, *Oct.*, 1938.—(1) The important characteristics of three groups of luminescent materials (phosphors) used in the construction of screens for kathode-ray tubes are described and some of the practical applications of these characteristics pointed out. (2) Some of the advantages and disadvantages of the "slow" screen tube, RCA 910, are discussed briefly and a description of the application of this tube to the study of heart sounds, or action currents from the heart and brain or peripheral nerves is made. (3) A method of erasing persistent phosphorescent tracings by means of exposing the tube screen to red light is presented. (4) The general arrangement of the "slow" screen and "fast" screen kathode-ray tubes together with some of the associated control equipment of the polyelectrophysiograph is described. This new laboratory instrument has proved extremely useful for both teaching and research. AUTHORS.

**4703. Radiography of Sections. P. Roland.** *Bull. de Photogrammétrie*, 81. *pp.* 1–38, *Jan.–March*, 1938.—This paper deals exhaustively with the geometrical conditions necessary for producing radiographs of one layer in a body. It is shown that, of the X-ray tube, body radiographed and photographic film, two must be moved in a related manner, and it is pointed out that in general the body cannot well be moved. Planigraphy and tomography are two of the possible systems. G. E. B.

**4704. Advantages of Non-Screen Radiography. H. H. Duerr.** *Am. J. of Roentgenology and Radium Therapy*, 40. *pp.* 283–290, *Aug.*, 1938.—The use of X-ray intensifying screens is discussed historically and with respect to photomicrographs showing the relative grain sizes of the film emulsion and screen particles. The effect of grain is to spoil sharpness of the photographic image and omission of the screens is preferable for thick body parts, particularly as non-use of intensifying screens allows inspection of the X-ray film by means of a magnifying glass. Special films have been produced for use with the thicker body parts without intensifying screen, these films having a photographic speed five or six times that of the usual films. Examples of the use of this new type of film, with a table of exposure times are given. B. J. L.

***4705. Tomography. G. B. Bush.** *Brit. J. of Radiology*, 11. *pp.* 611–622, *Sept.*, 1938.—A description is given of a simple apparatus for the production of tomographs, which consists of an attachment to an X-ray couch by means of which a traverse of 10″ is given to a Bucky grid and a transverse movement to an X-ray tube working at a focus film distance of 36″. The "depth of cut" was tested by the method of Twining [see Abstract 2829 (1937)]. The definition obtained appears to depend on (1) smooth movement of tube and film with no back lash in the connecting mechanism ; (2) use of fine focus tube ; (3) a focus film distance of 36″ ; (4) perfect immobilisation of the patient and (5) tube shift at right angles to long axis of tube using line-focus. The accuracy of calibration and definition over an area of 12″ × 10″ was tested by means of a phantom of 5 sheets of wire netting separated by 1 inch. Radiographs are shown of the "cuts" made for each sheet. Finally it is not claimed that this apparatus using a simple traverse can produce all the results of that of Des Plantes in which the more elaborate mechanism produces a circular and spiral movement of the tube and film. T. A. C.

**4706. Biological Experiments with a Condenser Discharge Type of X-Ray Tube. K. H. Kingdon, P. A. Zahl, C. P. Haskins and H. E. Tanis, Jr.** *Radiology*, 31. *pp.* 52–58, *July*, 1938.—Biological experiments are described using a condenser discharge X-ray tube capable of delivering a dose of 3·5 roentgens in 5 $\mu$.sec. Tests have been made of the validity of the Bunsen-Roscoe reciprocity law with eggs of *Drosophila melanogaster*, spores of *Aspergillus niger*, and wheat seedlings, a Coolidge tube operated at normal intensity being used as the source of radiation for the controls. No significant differences were found in the two sets of experiment, indicating the validity of the law over the range tested. Experiments have been made with the X-rayed material held in intense magnetic fields up to 23,000 oersteds, using the radiation from the Coolidge tube already mentioned, and the same biological materials. No appreciable effect of the magnetic field was found. Some implications of the work are considered. AUTHORS.

**4707. How X-Rays May Kill Cells. H. Rudisill and J. H. Hoch.** *Radiology*, 31. *pp.* 104–106, *July*, 1938.—A consideration of

previous work indicates that the autocatalytic mechanisms governing the reduction-oxidation equilibria of the respiration of cells are affected by X-rays. The effect of X-rays on this system in the case of yeast cells was studied by determining the time necessary for the re-appearance of the cytochrome C absorption band (550 m$\mu$) following irradiation and oxygenation. X-ray doses of from 3000 to 6000 r. cause an average initial increase in this re-appearance time of 225%. As it is known that X-rays produce nascent H and $H_2O_2$ from water it is suggested that the biological effects of the rays on cells may result from inactivation or destruction of cell respiratory mechanisms through the effect of these substances on the co-catalysts of the dehydrogenases. A number of well recognised biological effects of radiations are explained on this basis. J. E. R.

**4708. Biophysical X-Ray Effect. K. Staunig and J. Löbering.** *Kolloid Zeits.* 84. *pp.* 319–323, *Sept.*, 1938.—The hygroscopic absorption of fluid of animal tissues varies with the particular tissue and is modified if the tissue is submitted to X-rays, which may cause an increase or decrease of the maximum fluid absorption. It can be shown that the biological composition is not responsible for this variation but only the macro-molecular constitution of the preparation, the phenomena being analogous to changes in respect to viscosity. The effect is not reversible and is discussed in respect to the chemical composition and chemical chain formation. The effect is negative in carcinomatous change of the stomach tissue and apparently this is due to molecular change of the tissue and therefore offers a possible method of submicroscopical investigation of malignant tissues and new considerations in respect to X-ray therapy of cancer from electro-osmotic aspects. B. J. L.

**4709. Grenz-Ray Therapy. Z. A. Leitner.** *Brit. J. of Radiology*, 11. *pp.* 586–598, *Sept.*, 1938.—Grenz-rays are X-rays of wave-lengths between 1 and 3 Å produced at 6 to 12 kV in a tube with a very thin Lindemann glass window. The physical properties of these radiations are illustrated by means of curves showing spectral distribution, absorption in Al and absorption in skin. The latter shows that at 8 kV some 88% of the radiation is absorbed in the first 3mm. of tissue. The radiations are therefore generally used in the treatment of skin lesions, though they are reported to have a more general therapeutic application. The question of erythema production is discussed and considerable lack of agreement on the erythema dose is found among previous workers. A number of experiments have been carried out to determine this dose under various conditions and also the course of the erythema. Three waves of erythema are observed after a few hours, 10 days, and about 31 days, except in the case of small doses, and a distinct decrease in erythema dose with increasing kV is found. Curves are given showing the relation between dose and erythema, and it is found that these are similar to those for medium hard X-rays. J. E. R.

***4710. Dosage Chart for X-Ray Therapy. E. H. Quimby.** *Radiology*, 31. *pp.* 308–311, *Sept.*, 1938.—X-ray machines in U.S.A. are calibrated according to their output in air at some specified distance usually 50 cm. The International Committee for Radiological Units (Chicago 1937) made the additional recommendation that X-ray doses should be specified in terms of the numbers of röntgens delivered to the various skin fields. To obtain from calibration data, the number of röntgens delivered to the skin in a given time, or the time required for the administration of the number of röntgens delivered to the skin, it is

necessary to have available a table of back-scatter values for any qualities of radiation and fields which may be used. Charts have now been devised for such purposes consisting of three sections: (*a*) parallel straight lines providing for the determination of röntgens/min. delivered in air, at any distance, within the range in which the inverse square law holds (*i.e.* from 10–15 cm. outside the tube up to any desired distance) and (*b*) parallel straight lines providing for the determination of the time necessary for the delivery of any specified number of röntgens in air, when the output of the machine in röntgens/min. is known, and (*c*) a third set of parallel straight lines for the determination of the time required to deliver a specified dose on a particular skin field, when the time for the dose in air is known. For the measurement of the back-scatter factors used in the construction of these charts, see Abstract 3030 (1938). As these may be modified when the tissue thicknesses are less than 10 cm., a table is now given of the correction factors, necessary for thin parts of the body. T. A. C.

**4711. Effect of Filtration on Divergent Beams at Super-Voltages. H. S. Hayden, K. E. Corrigan and B. Cassen.** *Radiology*, 31. *pp.* 312–318, *Sept.*, 1938.—An account of experimental research on the effect of given filters in an X-ray beam generated at 500 kV, in order to find the best filter for therapy at this voltage. The theory is also developed. Conclusions reached include the following—an added filter in a beam of this radiation adds a component of hard scattered radiation to the beam and the quantity of scattered radiation is signficant; the quality of the filtered beam varies with the filter thickness and position and an improper filter may give a decreased depth dose. Filters were of Pb, with a secondary filter of Cu and Al to reduce the soft radiation, and diaphragms to control the effective beam. Curves and diagrams are reproduced. [See following Abstract.] E. H. W. B.

**4712. Attenuation and Transition Effects in the Absorption of Supervoltage Radiation. B. Cassen, K. E. Corrigan and H. S. Hayden.** *Radiology*, 31. *pp.* 319–324, *Sept.*, 1938.—A theoretical analysis of scattering and filtering of X-ray beams is given, and its application to therapy. Heterogeneous X-ray beams generated at from 300 to 1000 kV are considered. [See preceding Abstract.] E. H. W. B.

**4713. X-Ray and $\gamma$-Ray Protective Values of Building Materials. G. W. C. Kaye, W. Binks and G. E. Bell.** *Brit. J. of Radiology*, 11. *pp.* 676–685, *Oct.*, 1938.—Measurements of the lead equivalents of various building materials which may be used in providing protection for X-ray and radium workers have been made for X-rays excited at voltages up to 400 kV and for Ra $\gamma$-rays. The protective values increase with exciting voltage, reaching a maximum at about 100 kV, then fall to a minimum at about 200 kV and subsequently rise continuously. Protective values for X-rays excited at voltages up to 5,000 kV and for Ra $\gamma$-rays, have also been deduced, using theoretical and practical data relating to the energy distribution in X-ray and $\gamma$-ray spectra and to the photo-electric, scattering, and nuclear absorption processes. The satisfactory agreement between the experimental and computed values for X-rays excited at voltages between 200 and 400 kV and for Ra $\gamma$-rays suggests that the method can be applied to estimate the lead equivalent of a material at any voltage with an accuracy which is probably adequate for medical requirements. AUTHORS.

**4714. Existence of a Critical Intensity. W. H. Love.** *Brit. J. of Radiology*, 11. *pp.* 686–700, *Oct.*, 1938.—It has been found possible to make a complete analysis, based on recognised hypotheses, of the significance of radiation intensity in the determination of biological response. The analysis, which applies to any irradiated tissue, shows that the biological effect of a predetermined dose in a given tissue will, in general, be greatest for some particular value of the radiation intensity. The factors determining the existence of the critical intensity have been defined, and the evaluation of this intensity in any particular case is facilitated by several geometrical constructions and considerations. The relationship between the critical intensity and the radiation dose is briefly considered and attention is directed to the rôle of efficiency curves in the practice of radiation therapy. AUTHOR.

***4715. Development of H.V. X-Ray Tubes. C. C. Lauritsen.** *Radiology*, 31. *pp.* 354–361, *Sept.*, 1938.—An account is given of the development of a number of X-ray tubes working at voltages between 500 and 1200 kV at the California Institute of Technology. The most satisfactory tube has been used for therapeutic work at 900 kV*p* and 3 mA continuously since 1933. The tubes described were constructed of commercial glass cylinders and continuously evacuated. A porcelain tube is also described. The author goes on to discuss at length the relative merits of high and low voltages for clinical purposes. A detailed analysis of the problem of attenuation and true absorption shows that under normal clinical conditions percentage depth dose at 10 cm. should increase with *effective* voltage up to about 200 kV and then remain almost constant until well over 1000 kV. Thus there is some gain in increasing *tube* voltage up to 400 or 500 kV but no advantage from 500 to 1000 kV. If the dose at depths greater than 10 cm. is considered or if small beams are used there is a continuous increase above 500 kV. The question of a possible differential biological effect with wave-length is briefly considered. J. E. R.

***4716. Breakdown in X-Ray Tubes. N. C. Cordingly.** *Radiography*, 4. *pp.* 131–142, *Sept.*, 1938. A number of problems connected with the working of X-ray tubes and the precautions taken to deal with them are discussed. Manufacturing defects include loss of vacuum, inadequate degassing of metal parts, filament faults and insulation failures. Special consideration is given to the questions of reflected electronic bombardment and cold emission. Under working conditions breakdown of an X-ray tube may be due to destruction of the filament, caused by overheating or reverse emission, puncture of the glass envelope usually caused by excess voltage across the tube, failure of the anode cooling system, or overloading of the anode. In addition, the use of an excessive number of trial exposures, errors in screening technique, faulty instruments and short circuit of electrodes may lead to tube failure. A number of interlocked circuits designed to prevent some of the possible breakdowns are shown. J. E. R.

**4717. Characteristics of X-Rays. J. L. Weatherwax.** *Radiology*, 31. *pp.* 464–472, *Oct.*, 1938.—A useful outline for students taking a course in the Physics of Radiology, together with an extensive Bibliography covering a more complete survey of the subject.

***4718. $\gamma$-Ray and Neutron Generators and their Radiotherapeutic Possibilities. A. Bouwers.** *Radiology*, 31. *pp.* 89–93, *July*, 1938.—Experience gained in the design of h.v. generators for X-ray

production has been applied to investigations in nuclear physics. If a generator of 1MV is used for generating X-rays by accelerating electrons, reversal of the polarity will produce positive particles. Such positive particles can be produced in a tube with a perforated kathode, and are protons if the residual gas is $H_2$, deuterons in the case of $D_2$ and $\alpha$-particles in He. Cascade tubes are described, suitable for 1MV, and generators for up to 4MV. A brief account of some applications is given.

E. H. W. B.

*4719. **Recovery of Lost Radium. R. B. Taft.** *Radiology*, 31. *pp.* 340–344, *Sept.*, 1938.—The author has previously described [see Abstract 1843 (1937)] the Geiger-Müller counter for the detection of lost radium in medical applications. Further experiments are now described as to the distances at which this instrument is effective, experiments having been made in swimming pools and dust shoots. The instrument may be applied to detect, from the road, radium in the houses of operators, who may have stolen it, providing they have not taken the precaution to screen it.

B. J. L.

**4720. Radium Protection.** *Radiology*, 31. *pp.* 481–490, *Oct.*, 1938.—Contains the regulations set forth in the Revised Handbook, No. 18, of the National Bureau of Standards, incorporating the recommendations of the Advisory Committee on X-Ray and Radium Protection.

**4721. Quantum Theory of Biological Processes. P. Jordan.** *Naturwiss.* 26. *pp.* 537–545, *Aug.* 19, 1938.—The greater part of the paper is devoted to a historical survey of the quantum interpretations of biological processes, and in particular of the biological action of radiations. The theoretical and experimental work examined leads to the conclusion that a single quantum jump in a single molecule of a cell may influence the whole life function of the cell. It is then suggested that a gene is a single large molecule containing $10^4$ to $10^6$ atoms, a gene mutation resulting from a quantum change in this molecule.

J. E. R.

**4722. Biological Effect of Kathode Rays. C. P. Haskins.** *J. of Applied Physics*, 9. *pp.* 553–561, *Sept.*, 1938.—The paper opens with a theoretical discussion of the effect of X-rays and kathode rays on biological material, as a result of which it was decided to construct a kathode-ray tube suitable for work with biological material. The tube gives electron beams of high homogeneity at energies from 1 to 15 ekV and currents of the order of $10^{-9}$ to $10^{-7}$ A. Under such conditions the specimens themselves must be within the evacuated system. They are arranged on a rotating holder, which carries 28 specimens and which faces a slit in a specially designed "raying box" which is connected to the kathode-ray tube proper. This holder also carries a Faraday cage with a lead to a sensitive electrometer in order to allow for measurements of the intensity of the beams. Arrangements are also described for the study of cancerous material which cannot be placed *in vacuo*. Certain preliminary experiments with *aspergillus* and *penicillium* are described, particularly with reference to killing and mutation.

G. G.

*See also* Abstracts 4644 and

3254B. Method of Producing Intensive X-Ray Flashes. M. Steenbeck.
3255B. Radiological and Electro-Medical Apparatus. R. S. Whipple.

## OSCILLATIONS AND WAVES.

**4723. Fluctuations of an Auto-Oscillating System. I. Berstein.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 20. 1. *pp.* 11–16, 1938. *In English.*—A mathematical investigation of the problem of fluctuations in an auto-oscillating system with one degree of freedom, the system approximating closely to a linear conservative one. A solution is obtained in general terms, and the spectrum of the oscillation determined. The general formulæ are then applied to the system of the dynatron oscillator, the diffuseness of the spectrum and the mean square of the amplitude fluctuations being estimated. J. P. A.

**4724. Attenuation of Ultra-Short Radio Waves Along the Earth. S. R. Khastgir and M. K. Chakravarty.** *Indian Journ. Phys.* 12 *pp.* 289–297, *Aug.*, 1938.—Relative field-strength was measured at different distances along a straight line over level earth from a portable ultra-short wave transmitter fitted with a quarter wave aerial. The transmitter was of sufficient power to enable field-strength measurements to be carried out with accuracy up to a distance of 50 m. from the transmitter. A wave-length of 3·64 m. was employed for the purpose. The receiver used was a heterodyne receiver with an oscillator-detector circuit followed by l.f. power amplification. The l.f. alternating voltage developed across the telephones in the output circuit, when the transmitter was on, was measured by a sensitive valve-voltmeter constructed for the purpose. Before any attenuation measurement was made, the frequency of the beat-note was adjusted whenever necessary, and brought in tune with the fixed note of a Galton whistle. All readings were taken through telescopes situated at some distance. The attenuation measurements have been examined in the light of Norton's formula for ground attenuation of radio waves from a short dipole aerial. The values of the electrical conductivity $\sigma$ and dielectric constant $\epsilon$ of the ground which give agreement with Norton's formula are : $\epsilon=7$ e. s. u., $\sigma=0\cdot91\times10^{-14}$ e. m. u. The values for moist ground are however larger, *viz.*, $\epsilon=10$ e. s. u., $\sigma=1\cdot82\times10^{-14}$ e. m. u. It is significant that these values agreed in their orders of magnitude with the values obtained by the direct laboratory method. Authors.

**4725. Scattering of Radio Waves by the F-Region of the Ionosphere. H. G. Booker and H. W. Wells.** *Terr. Mag.* 43. *pp.* 249–256, *Sept.*, 1938.—Records are reproduced showing diffuse echoes from the F-region of the ionosphere received continuously at night in equatorial regions over a wide range of wave-frequency. They are interpreted as due to Rayleigh scattering by spatial irregularities in the distribution of electron-density at or above a definite level in the F-region. Because of the highly dispersive nature of the ionosphere, there is no marked dependence of Rayleigh scattering upon wave-frequency such as there is for a non-dispersive medium. According to this interpretation, variation of the maximum wave-frequency to which diffuse echoes can be followed has nothing to do with variation of the maximum electron-density of an ionospheric region, but merely indicates variation in the size of irregularities in electron-density. Scattering of this type may have some bearing upon the phenomenon of persistence of E-region echoes to wave-frequencies greater than the critical penetration-frequency of the E-region. Authors.

**4726. Production of Ionospheric E- and F-Regions and Lower-Altitude Ionisation Causing Radio Fade-Outs. O. R. Wulf and L. S. Deming.** *Terr. Mag.* 43. *pp.* 283–298, *Sept.*, 1938.—Ionisation responsible for radio fade-outs, not generally believed to be caused by u.v. solar radiation, presents an interesting problem particularly because of the relatively low altitude at which it occurs. It appears that the known E- and F-regions may be explained as arising from absorptions of solar radiation by atmospheric $O_2$ and $N_2$. Intense absorption by $O_2$ in the relatively near u.v. seems to give assurance that $O_2$ will first be encountered in appreciable amounts by incoming solar radiation in the vicinity of 100 km., the oxygen above this height being maintained in the atomic form by the dissociating action of the absorbed radiation. In the vicinity of 100 km. $O_2$ presumably sets in abruptly and rises rapidly to relatively high densities, leading to a narrow region within which all strong absorption by $O_2$, including ionising absorption, is confined. Dispersion-measurements in $N_2$ indicate two absorptions due to this gas in the far u.v., the positions of which are compared with spectroscopic data. These absorptions with two other absorptions due to O and N atoms produced by the primary molecular absorptions, are utilised in attempting to account for the normal ionosphere. The F-region is attributed to the nitrogen absorptions, and the E-region to the oxygen absorptions. It is concluded that the ionisation producing radio fade-outs probably cannot be due to a far u.v. radiation because of its remarkably low altitude and its intensity, and that such ionisation seems to require the presence of a new constituent, not present at greater heights, which possesses broad absorption in the near u.v. It is considered possible that radiation absorbed by $O_3$ produces this ionisation. A laboratory-experiment of some importance in this connection is suggested. AUTHORS.

**4727. Effects Caused in the Ionosphere by Electric Waves. Part II. V. A. Bailey.** *Phil. Mag.* 26. *pp.* 425–453, *Oct.*, 1938.—Following on Part I of a general investigation [see Abstract 2844 (1937)], the present publication contains a more complete study of resonance in gyro interaction, and shows that: 1. The resonance curves may have either one or two maxima depending on the height at which the auxiliary wave is reflected. 2. With an appropriate and simple aerial system observable interaction can be caused by radiating, in the form of a directed gyro wave, a power as low as 50 W. It is also shown that in latitudes distant from the equator an easily visible electric discharge can be produced in the ionosphere, at levels between 70 and 96 km. high, by means of a suitable aerial system radiating 500 kW of power in the form of a concentrated gyro wave, and that by increasing this power to $2 \times 10^6$ kW it is probable that at the least the minimum illumination 0·02 foot-candle prescribed for roadways would be produced over an area of about 10,000 km$^2$. AUTHOR.

**4728. Ionosphere and its Influence on the Propagation of Electric Waves. W. Dieminger.** *Ergeb. d. exakt. Naturwiss.* 17. *pp.* 282–324, 1938.—After reviewing the various echo methods of investigating the upper layers of the ionosphere and discussing modern theories of the ionosphere and wave propagation, an account is given of the results obtained in numerous investigations including (*a*) normal effects, (*b*) abnormal phenomena and (*c*) the propagation of short, medium and long waves. It is concluded that the modern picture of the ionosphere obtained from numerous experimental and theoretical investigations is thoroughly

established. The agreement between theory and observation is in many points very good and relations with other natural phenomena are in many cases in clear evidence, so that ionosphere investigation has now become an important branch of geophysics. Further knowledge is particularly desirable in the case of the phenomena of the $F_2$-layer and of abnormal effects. In this connection a considerable extension of our knowledge of certain solar and cosmic phenomena is to be expected. The theory of the ionosphere also needs modification in certain respects in order to obtain satisfactory agreement with observational results. For practical radio communication further investigation of the exact connection between the ionosphere and wave propagation is of the greatest interest, particularly with reference to the choice of wave-length best suited for different times and different distances. A. W.

*See also* Abstracts **4372, 4435, 4623, 4631, 4699,** and **3334B.** Electrical Resonator. W. W. Hansen.

## PHOTOELECTRICITY.

**4729. Time Lag in Gas-Filled Photoelectric Cells. A. M. Skellett.** *J. of Applied Physics,* 9. *pp.* 631–634, *Oct.,* 1938.—Time lag measurements are described which were made with a light chopper on a gas-filled cell of special design. The resulting response *vs.* frequency characteristic curve exhibits the resonance oscillations predicted from theory and calculation of the lag from the positive ion mobility agrees with that determined from this curve. The construction of the cell is such that secondary emission and disintegration of the kathode by ion bombardment are eliminated even at high values of gas amplification. AUTHOR.

*See also* Abstracts **4292, 4331, 4563.**

## PIEZOELECTRICITY.

*See* Abstract **4612.**

## THERMIONICS.

**4730. Thermionic Emission of Pt in $H_2$ and $O_2$. S. Kalandyk.** *Acta Physica Polonica,* 7. 1. *pp.* 68–80, 1938. *In German.*—The variation with time of the negative emission from Pt in $H_2$ was investigated. It is found that a preliminary treatment with $O_2$ increases the thermionic activity considerably. At about 1400° C. a surface compound (perhaps PtH) is formed, the emission becoming independent of the $H_2$ pressure. With $H_2$ pressures in the region of 0·1 mm. Hg the emission is found to be proportional to the square of the pressure, but at lower pressures it is proportional to the pressure. The variation of emission with temperature was studied, and values for the work-function and the constant $A$ in Richardson's equation were calculated. With $D_2$ in place of $H_2$ no essential differences were found. The absence of positive emission from Pt in $H_2$ was definitely established. The positive emission in $O_2$ was found to fall indefinitely with time. At constant temperature, the emission is proportional to $p^z$ ($p$ = pressure, $z$ = constant which depends on the temperature). Values for the work function and the constant $A$ are given. D. H. F.

**4731. Electron Microscope Study of Thoriated Tungsten. A. J. Ahearn and J. A. Becker.** *Phys. Rev.* 54. *pp.* 448–458, *Sept.* 15, 1938.—The behaviour of electron images of thoriated W ribbon is

examined with the electron microscope; comparison with photomicrographs shows that the active and inactive patches which compose the electron image agree dimensionally with the exposed grains of W. The electron microscope shows that the Th comes to the surface in eruptions at a relatively small number of points located at random. It is also shown that all the Th in a globule comes to the surface when an eruption occurs. The frequency of eruption is affected by sudden heating or cooling of the filament and by high temperature flash. The eruptions are the only observed manner in which Th arrives at the filament surface and the factors which determine their arrival are briefly described. In a single crystal ribbon there is a strongly preferred direction of migration of the Th from the eruption centres whilst in a polycrystalline ribbon it is isotropic. The relative emission from different grains and the work function differences between them are described. H. J. H. S.

**4732. Change of Electron Exit Work on Activation of Oxide Kathodes. W. Heinze and S. Wagener.** *Zeits. f. Physik*, 110. 3–4, *pp.* 164–188, 1938.—The change of the electron exit work brought on at the activation by oxide kathodes was measured. It was found that the increase of the emission on activation is caused solely by a decrease of the exit work. The emission mechanism may be fully interpreted on the analogy of the emission equation established for pure metals: $i_s = AT^2 e^{-\Psi_o/KT}$, in which the exit work $\Psi_o$ is composed of an outer and an inner exit work. It is probable that only the internal exit work changes on activation. [See Abstract 1863 (1937).] J. J. S.

*See also* Abstracts 4365, 4582.

## THERMOELECTRICITY.

***4733. Amplification of Thermo-E.M.F.s. R. Gunn.** *Rev. Sci. Instruments*, 9. *pp.* 267–269, *Sept.*, 1938.—Experiments employing a new type of regenerative d.c. amplifier have shown that such equipment is unsuited for use, except, perhaps, in the laboratory. A successful system of amplification employing valve amplifiers and commutators for inverting and synchronously rectifying the resulting amplified alternating potentials is described. Thermo-e.m.f.s less than $10^{-9}$ V are readily indicated on a portable microammeter. The over-all useful amplification with portable equipment exceeds 50,000. Author.

***4734. Tungsten Fuses. T. Utiyama and R. Arai.** *Electrot. Laborat. Tokyo, Japan, Circ. No.* 110. [42 *pp.*], 1938. *English Abstract.*—The tungsten fuses which are available on the market at present are studied with respect to fusing characteristics, comparison with various fuse metals, construction, range of rated current, short-circuit tests, insulation tests after the fuse is blown out, ageing characteristics, internal resistances, effects of the dimensions of lead wire and glass tube, coordination of fuse and loading, etc. The results of these investigations show that the most serious defect of the tungsten fuse is an irregularity of its fusing which is due to imperfect contact of the tungsten element and the lead wire, as they are only pressed together by hammering. If welded perfectly the characteristics of the tungsten fuse would no doubt be improved. The use of tungsten fuses makes the control of the over-load current much simpler and cheaper than with the current limiter. Authors

*See also* Abstracts 4365, 4579.

*A star (*) indicates that the Abstract deals with Apparatus and Instruments.*

## DECEMBER, 1938.

# GENERAL PHYSICS.

### ADSORPTION (see Surface Properties).

### ATOMIC AND MOLECULAR STRUCTURE.

**4735. $\alpha$-Particle Model of the Nucleus. L. R. Hafstad and E. Teller.** *Phys. Rev.* 54. *pp.* 681–692, *Nov.* 1, 1938.—This paper reviews the theory of nuclei composed of $\alpha$-particles alone, and extends it to cases where in addition to the $\alpha$-particles, a single neutron or proton is present, and also to those light nuclei in which a single neutron or proton is missing from the complete $\alpha$-particle structure. In the latter cases the missing particle is considered as a neutron or proton "hole." In the first section of the paper, the configuration of the $\alpha$-particles is considered together with the motion of the neutron, proton, neutron hole, or proton hole, in the field of the fixed $\alpha$-particles for nuclei lighter than F. Rough values for the binding energies are obtained and compared with the results of the Hartree model. In the second section of the paper, rotations of the same nuclei are discussed, and the symmetry properties of the fundamental states, as well as the symmetry properties and the approximate spacing of some of the excited states are obtained. The symmetry properties of the fundamental states are in agreement with those obtained from the independent-particle model. Furthermore the excited states as obtained from the two models show a marked parallelism, although a greater number of levels is predicted by the $\alpha$-particle model than by the independent-particle model. AUTHORS.

**4736. Binding Energy of $Li^6$. H. Margenau and K. G. Carroll.** *Phys. Rev.* 54. *pp.* 705–713, *Nov.* 1, 1938.—The mass defect of $Li^6$ has been calculated with the use of a symmetric Hamiltonian. Perturbation theory was employed in the main part of the work, and an upper limit for the contribution of all functions to the first and second-order perturbation energies was obtained. This upper limit is 10% smaller than the experimental binding energy. It was then shown on the basis of variational calculations that perturbation theory, carried to this stage, overshoots the mark, and the upper limit to the binding energy is reduced to 26 eMV, which is 6 eMV short of the experimental value. These figures are based on a set of nuclear constants which favour large mass defects. The perturbational effect of all doubly excited configurations upon the $^3D$-state of $Li^6$ was investigated and compared with the effect of similar functions upon the $^3S$-state. The result is that the first order $^3D - {}^3S$ splitting, which is about 2 eMV, is enlarged to 6 eMV, both levels being depressed. AUTHORS.

**4737. Theory of Hydrogen Molecule. T. Inui.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 770–779, *Sept.*, 1938.—In this mathematical paper the treatment of the $H_2$ molecule by the Fock method is investigated, and a simple procedure developed which admits of the description of the electronic states of molecules in terms of orbitals. H. H. Ho.

**4738. Structure of $PCl_5$. M. Rouault.** *Comptes Rendus*, 207. *pp.* 620–622, *Oct.* 10, 1938.—Electron diffraction measurements of $PCl_5$

vapour at 100° agree with the assumption that the molecule of $PCl_5$ is a trigonal bipyramid with P in the centre, three atoms of Cl in the same plane therewith at distances $l_1$, and two at the summits of the pyramids at distances $l_2$: $l_2/l_1 = 1{\cdot}07$, which assuming $l_1 = 2{\cdot}10$ Å and $l_2 = 2{\cdot}25$ Å gives 3·08 Å as the minimum distance between two atoms of Cl. [See Abstract 1344 (1936).] C. A. S.

**4739. Structures of S, V and Cr Compounds. K. J. Palmer.** *Am. Chem. Soc., J.* 60. *pp.* 2360–2369, *Oct.*, 1938.—The molecular structures of SCl, $SCl_2$, $SOCl_2$, $SO_2Cl_2$, $SO_3$, $VOCl_3$, and $CrO_2Cl_2$ have been investigated by the electron diffraction method. The final values of the interatomic distances and angles are given. It has been shown that $SO_2Cl_2$, $VOCl_3$ and $CrO_2Cl_2$ have tetrahedral configurations which are, however, considerably distorted. $SOCl_2$ is pyramidal, and $SO_3$ planar. SCl has been shown to have one Cl atom attached to each S atom. The positions of the Cl atoms cannot be determined with certainty. Author.

**4740. Structures of Hexacarbonyls of Cr, Mo and W. L. O. Brockway, R. V. G. Ewens and M. W. Lister.** *Faraday Soc., Trans.* 34. *pp.* 1350–1357, *Nov.*, 1938.—The molecular structures of Cr, Mo and W hexacarbonyls have been investigated by the method of electron diffraction by the vapour. The most probable molecular model is represented by a regular octahedron with the metal atom at the centre and the six CO groups directed towards the apices. It is assumed that the CO groups are attached to the metal atom through the C atoms. The Cr-C bond length, $1{\cdot}92 \pm 0{\cdot}04$ Å, is about 0·08 Å greater than in the corresponding bonds of Fe and Co nitrosyl carbonyls and Ni carbonyl. Since these molecules are isoelectronic with the Cr carbonyl, the greater distance in the latter is evidently related to the greater number of groups attached to the Cr atom. The Mo-C and W-C bond lengths are $2{\cdot}08 \pm 0{\cdot}04$ Å and $2{\cdot}06 \pm 0{\cdot}04$ Å. Authors.

**4741. Structures of $MoCl_5$ and $WCl_6$. R. V. G. Ewens and M. W. Lister.** *Faraday Soc., Trans.* 34. *pp.* 1358–1362, *Nov.*, 1938.—The structures of $MoCl_5$ and $WCl_6$ have been investigated by electron diffraction of the vapours. $MoCl_5$ is a trigonal bipyramid, with $Mo-Cl = 2{\cdot}27 \pm 0{\cdot}02$ Å and $WCl_6$ is a regular octahedron with $W-Cl = 2{\cdot}26 \pm 0{\cdot}02$Å. Authors.

**4742. Atomic Distribution in Allotropic Forms of Phosphorus at Different Temperatures. C. D. Thomas and N. S. Gingrich.** *J. Chem. Phys.* 6. *pp.* 659–665, *Nov.*, 1938.—Monochromatic X-ray diffraction patterns of liquid yellow, amorphous red and amorphous black P were obtained, using Mo K$\alpha$ radiation. The effect of temperature upon these patterns was investigated for the first two forms. Analysis of these patterns led to the determination of the atomic distribution curves in each case. The number of nearest neighbours is three for all forms. This is taken as direct proof of the existence of $P_4$ molecules in liquid yellow P. Comparisons are made of the atomic distribution curves of each form and at the different temperatures for liquid yellow and amorphous red P. Authors.

*See also* Abstracts **4903, 4924, 4956, 4957.**

## COLLOIDS.

**4743. Formation of Gold Sols in Alkaline Solutions. L. L. Bircumshaw.** *Faraday Soc., Trans.* 34. *pp.* 1236–1239, *Oct.*, 1938.—For the immediate production of a red gold sol by the reduction of an

alkaline solution of gold by formaldehyde it appears to be necessary that the *whole* of the gold should be present in the solution as aurate. AUTHOR.

**4744. Production of Aerosols by Spraying Solutions. G. Jander and E. Wygasch.** *Kolloid Zeits.* 85. *pp.* 1–8, *Oct.*, 1938.—The production of aerosols by the spraying of solutions of KI was investigated. It was found that the aerosols were reproducible, that the average mass of the particles was a function of the concentration of the solution, and that the initial concentration of the cloud varied with the volume of solution dispersed. The range of sizes present in a given cloud was large and increased with increasing concentration of the solution, while a corresponding decrease in the stability was observed. [See also Abstract 23 (1937).] W. H. Wal.

**4745. Influence of Dispersity on Dynamic Birefringence of Colloids. C. Sadron.** *J. de Physique et le Radium*, 9. *pp.* 381–383, *Sept.*, 1938.—Results previously obtained for monodisperse media [see Abstract 911 (1938)] are now generalised to cover solutions containing particles of differing shapes. General formulæ are obtained giving the position of the neutral lines and the birefringence of such a medium. The theory is tested numerically in the case of two components, and it is shown how different the variation of the position of the neutral lines as a function of velocity gradient can be from that observed in monodisperse systems. [See following Abstract.] C. B. A.

**4746. Dynamic Birefringence of Polydisperse Systems. C. Sadron and H. Mosimann.** *J. de Physique et le Radium*, 9. *pp.* 384–386, *Sept.*, 1938.—Curves of dynamic birefringence are given for a number of polydisperse media. The results agree with those calculated [see preceding Abstract] so that this method indicates rapidly whether a colloidal system is polydisperse or not. Measurements made with a fractionated nitrocellulose show that the small residual polydispersity is sufficient to cause an appreciable perturbation at large values of velocity gradient. C. B. A.

**4747. Stretching of Heated Polystyrene Films. G. van Iterson Jr. and K. E. C. Buyn.** *Kolloid Zeits.* 85. *pp.* 60–70, *Oct.*, 1938.—Strips of polystyrene cut along and perpendicular to the direction of rolling were heated above 90°C. under various loads. The strips shortened or stretched, and sometimes stretching succeeded shortening. Double refraction was measured before and after heating. A theoretical explanation of the more important phenomena is given, based on the Fransen theory and on a kinetic theory. P. H. B.

**4748. States of Dust. O. Brandt.** *Kolloid Zeits.* 85. *pp.* 24–32, *Oct.*, 1938.—The author describes three states in which dust may exist, (1) suspended in a gas (schwebezustand), $k=1$; (2) as a self-supporting structure with no part of the weight carried by the gas (lagerzustand), $k=0$; (3) in a state of flow in which part of the weight of the dust is borne by the gas (fliesszustand), $0<k<1$. These states are defined by the value of the flow-factor (k), the fraction of the total weight of dust which is carried by the gas. An account is given of an experimental investigation of states (2) and (3). W. H. Wal.

**4749. Constant of Sedimentation by Ultracentrifuge. M. Paić.** *Comptes Rendus*, 207. *pp.* 629–632, *Oct.* 10, 1938.—If the concentrations of a solution before and after centrifuging, and the mode of the centrifuging, be known, the constant of sedimentation may be calculated. In general, the mode of centrifuging is ill-defined. The uncertainty arising from

this cause may be avoided by determining the relative value of the constant of sedimentation by comparison with a second substance.
W. H. Wal.

**4750. Kataphoresis and Sedimentation Potential. J. J. Hermans.** *Phil. Mag.* 26. *pp.* 650–674, *Nov.*, 1938.—When charged spherical particles move in an electrolytic solution the double layer is deformed. The theory of this phenomenon can be developed if the double layer is very thin as compared with the radius of the particle. This is worked out for the motion under the influence of an external electric field (kataphoresis), and for a motion in the absence of an external electric field (sedimentation potential). The final formula for the kataphoretic velocity shows (1) that maxima may occur in the kataphoretic velocity with continually increasing absolute value of the $\zeta$-potential ; (2) that the charge of the particles as calculated from the kataphoretic velocity will not as a rule tally with the charge determined by direct means, particularly if the particle is a conductor ; (3) that the electroosmotic and kataphoretic velocities will only be the same in special cases, and then only approximately. From the formula for the sedimentation potential it can be concluded that sedimentation potentials of some 10mV may occur when large particles fall down in distilled water under the influence of gravitation. The formula may be applied to study the process of sedimentation, and may sometimes be useful to compute the $\zeta$-potential of large particles where no measurement of kataphoretic velocity is possible. Finally, it may be added that the distortion of the double layer will contribute to the dielectric constant of the systems considered. The sign of this contribution will to a large extent depend on the sign of $\zeta\Sigma n_k e_k^3$. The author hopes to deal later with this problem in more detail. AUTHOR.

**4751. Charged Colloid Particles in an Ultrasonic Field. Part II. J. J. Hermans.** *Phil. Mag.* 26. *pp.* 674–683, *Nov.*, 1938.—A plane sonic wave is assumed to move in a suspension of spherical particles. These particles lagging behind the solvent, their double layer is deformed, and a dipolar moment is set up. Summing up these dipolar moments for all the particles, and integrating for a quarter of the sonic wave, the p.d. $\phi$ between a node and an antinode is found. The diffuse double layer round the particles is assumed to be thin as compared with their radius. It is found that the value of $\phi$ is maximum in the special case—interesting from both a hydrodynamical and a colloid-chemical point of view—where the flow of liquid round the particle becomes different from that of uniform motion, a phenomenon which is due to the inertia of the liquid. In this case the p.d. $\phi$ may amount to the remarkably high value of some volts. Measurements of $\phi$ may lead to a better understanding of the nature of many suspensions of colloidal solutions and their behaviour in a sonic field. Moreover, the effect may sometimes be useful to determine the $\zeta$-potential of particles which are too large to enable a determination of kataphoretic mobility. [For Part I see Abstract 1388 (1938).] AUTHOR.

**4752. X-Ray Diffraction Studies on Heavy-Metal Ferrocyanide Gels. H. B. Weiser, W. O. Milligan, and J. B. Bates.** *J. Phys. Chem.* 42. *pp.* 945–954, *Oct.*, 1938.—Gels of heavy-metal ferrocyanides carry down much alkali ferrocyanide. $Cu_2Fe(CN)_6$ precipitated in the presence of excess Cu is practically pure and gives a definite X-ray diffraction pattern. When precipitated with excess $K_4Fe(CN)_6$ the diagram is unaltered although the gel may have adsorbed considerable quantities

of $K_4Fe(CN)_6$. The adsorbed ferrocyanide is thus not in the form of a double salt. Cu, Co, Ni, and Mn ferrocyanides are isomorphous and have almost identical lattice constants. With Zn, Cd, and Ag ferrocyanides a double salt is formed with $K_4Fe(CN)_6$ in each case. A. J. M.

**4753. Hydrous Oxide Hydrosols and Gels. A. Ganguli.** *Acta Physicochimica*, 9. 1. *pp.* 197–201, 1938. *In English.*—Freshly prepared sols and gels of hydrous oxides are truly amorphous. In accordance with the views of the author [see Abstracts 1476 and 3354 (1937)] on the amorphous state these consist of long-chain complexes. During the course of ageing and desiccation the amorphous bodies pass to the polycrystalline and finally to the crystalline forms. The thixotropy, gelation and high viscosity of these sols, the swelling of gels and the X-ray patterns are explained on the above view. AUTHOR.

*See also* Abstracts 4773, 4832, 4999.

## CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

**4754. Crystallographic Radii. H. Jensen, G. Meyer-Gossler and H. Rohde.** *Zeits. f. Physik*, 110. 5–6. *pp.* 277–290, 1938.—There exists a definite relationship between the lattice constants of ionic crystals. The lattice spacing is formed by the placing together of the individual ions, *i.e.* a definite radius can be assigned to an ion, which is independent of the type of binding. The lattice constant is thus the sum of the ionic radii. The physical significance of these concepts is established by a quantum-mechanical treatment. The calculations show that the radius of an ion is independent of its neighbours and that the additive law holds. The computed radii lie close to the Goldschmidt values. A numerical solution of the Fermi equation is given in an appendix. C. J. B. C.

**4755. Classification of Solids. W. Nowacki.** *Zeits. f. Krist.* 100. 1. *pp.* 77–81, 1938.—Strock [see Abstract 1420 (1936)] has given a classification of solid bodies, but there are several unsatisfactory features in his treatment, *e.g.*, in dealing with lattices with rotating atom groups. A classification is now given which will represent all the yet known cases and deviations from mathematical structure theory. C. J. B. C.

**4756. Graphical Representation of the Possibilities of Rotation Axis Combinations. H. Tertsch.** *Zeits. f. Krist.* 100. 1. *pp.* 85–90, 1938.—Rotation axes have been discussed in a previous publication [see Abstract 28 (1938)]. Combinations of two-, three-, four- and six-fold rotation axes are discussed and represented graphically. C. J. B. C.

**4757. Vector Maps and Crystal Analysis. I. Langmuir and D. Wrinch.** *Nature*, 142. *pp.* 581–583, *Sept.* 24, 1938.—The authors discuss, from a geometrical standpoint, the construction of vector maps from distributions of point intensities giving examples showing how the expressions derived are applied in turn to 1,- 2- and 3-dimensional crystals. The illustrations show that by this method of interpreting vector maps it is possible to deduce details of the structure of the insulin molecule. J. I.

**4758. Potential Energies of Alkali Halides—Errata and Extension of the Semi-Empirical Formula. A. May.** *Phys. Rev.* 54. *pp.* 629–633, *Oct.* 15, 1938.—A correction is first made of the author's previous calculations for CsCl [see Abstract 3834 (1937)], in which an incorrect empirical value was used. By extending the method of Born and Mayer, six constants in the potential energy expression for CsCl are evaluated from available measurements on the lattice and vapour. The results so obtained

are then applied to other alkali halides, and permit the determination of the interionic distances in the gas, the lattice energies and heats of sublimation. The agreement with empirical data is satisfactory for the interionic distances, but is otherwise poor. AUTHOR.

**4759. Diffraction of X-Rays by an Age-Hardening Cu-Al Alloy. G. D. Preston.** *Roy. Soc., Proc.* 167*A*. *pp.* 526–538, *Sept.* 23, 1938.—A 4 % Cu alloy is synthesised from high purity metals, drawn to 1 mm. wire, and annealed at 500° C. ; the 2-5 mm. crystals which it contains after this treatment being examined by oscillating crystal and Lane methods, with hot kathode Cu radiation at 40 kV (r.m.s.), 10-15 mA, and exposures of 1-1½ hr. Age hardening for 26 days at 150° C. or 10 hr. at 200° C. is associated with segregation of Cu atoms on (100) planes as suggested by Desch in 1934. On ageing at 200° C. for 10 hr. one satellite disappears, an intermediate phase being then present in the alloy. It is difficult to say whether the crystal is now single-phase or duplex, but at earlier stages the Cu atoms are still in substitutional solid solution in the Cu lattice. Where it is segregating it is not present in sufficient quantity to give a CuAl precipitate, and the alloy seems to resemble the Fe-Ni-Al alloys of high coerciveness described by Bradley and Taylor. ["Magnetism", Lecture VI, *p.* 91. *Institute of Physics.* 1938.] D. R. H.

**4760. Structure of Fe-Pd Superlattices. R. Hultgren and C. A. Zapffe.** *Zeits. f. Krist.* 99. 6. *pp.* 509–512, 1938.—FePd and $FePd_3$ are studied by means of powder photographs. When quenched from above 700° C. FePd has a "disordered" cubic structure. Quenched from 650° C. or below the structure is tetragonal and "ordered". $FePd_3$ can also exist in the "ordered" and "disordered" states but remains cubic. For both FePd and $FePd_3$ ordering is accompanied by an increase in the volume of the unit cell. J. T.

**4761. X-Ray Test of Superstructure in $FeNi_3$. F. E. Haworth.** *Phys. Rev.* 54. *pp.* 693–698, *Nov.* 1, 1938.—A search has been made for superstructure in permalloy of composition near $FeNi_3$. Curves of X-ray scattering power near the absorption edges of Ni and Fe show that Fe K$\beta$-radiation should give the strongest superstructure lines, and calculations indicate that reflection from (321) planes of a perfectly ordered structure should have about one-seventh the intensity of the ordinary (222) reflection. The specimen was a powdered alloy containing 70% nickel, annealed at 1000° C. and baked at 425° C. It was placed in a focusing camera in a beam of Fe K$\beta$-rays which were selected and concentrated by a curved rock-salt crystal, and exposed for 100 hr. No superstructure lines appeared, although superstructure in $\beta$-brass was easily detected with similar technique. This negative result, which is supported by a considerable amount of indirect evidence, indicates that no long range order exists in $FeNi_3$. AUTHOR.

**4762. Structure of Aliphatic Compounds: $n$-$C_{30}H_{62}$. R. Kohlhaas and K. H. Soremba.** *Zeits. f. Krist.* 100. 1. *pp.* 47–57, 1938.—The preparation of the $n$-paraffin $C_{30}H_{62}$ is described. Single crystals are obtained, and investigated by means of the rotating crystal method. They are orthorhombic with $a = 7{\cdot}452$, $b = 4{\cdot}965$, $c = 81{\cdot}60$ Å ; density = $0{\cdot}939$ ; 4 mol. per unit cell ; space-group = $D_{2h}^{16}$. The following molecular dimensions are given, distance between C-atoms in direction of chain = 1·26 Å, diameter of C-atom = 1·57 Å, angle between adjacent C-atoms = 106·0°. The chains lie in the (110) plane and the distance between consecutive molecules is 4·2 Å, while the smallest distance be-

tween neighbouring $CH_2$ groups is 2 Å. The structure is discussed in relation to that of other paraffins. J. I.

**4763. X-Ray Analysis of Structure of Water. J. Morgan and B. E. Warren.** *J. Chem. Phys.* 6. *pp.* 666–673, *Nov.*, 1938.—X-ray diffraction patterns of water were obtained at five temperatures: 1·5°, 13°, 30°, 62°, and 83° C. The radiation was Cu K$\alpha$ and Mo K$\alpha$, monochromated by reflection from a rock-salt crystal. Radial distribution curves for water at the five temperatures were obtained by a Fourier analysis of the X-ray intensity curves. The first peak is only partially resolved, and it is not possible to interpret the distribution curves uniquely in terms of a definite number of neighbours at definite distances. The results can be interpreted in terms of a structure in which the tendency of a water molecule to bond itself tetrahedrally to four neighbouring molecules is only partially satisfied. AUTHORS.

**4764. Structure of Nematic Layers. H. Zocher and G. Ungar.** *Zeits. f. Physik*, 110. 9–10. *pp.* 529–548, 1938.—The interference figures in parallel polarised light afforded by the homogeneous regions of nematic layers of thicknesses up to 1 mm. have been observed and partly photographed in convergent polarised light. The curves obtained for two kinds of simply deformed zones are found to correspond with those derived from the Oseen differential equations and the assumed boundary conditions. It is established by the quantitative evaluation of the interference figures from homotropic regions of *p*-acetoxybenzalazin in layers up to 1 mm. thickness, that the parallel orientation of molecules, even in layers of such thickness, extends throughout the whole of the layer from one boundary surface to the other, and is not restricted to thin marginal layers as assumed in the swarm theory. The paper is replete with experimental details and illustrations. H. H. Ho.

**4765. Polymorphic Transformation of Mercuric Iodide. D. G. Eade and N. H. Hartshorne.** *Chem. Soc., J. pp.* 1636–1646, *Oct.*, 1938.—The paper describes the results of direct measurements of the linear rate of movement of the interface between red and yellow $HgI_2$ in thin polycrystalline films. From 0° to 40° (yellow → red), where the transformation is directed towards the denser form, the interface starts preferentially at the edges of the film and the rate shows a decline with time at constant temperature, given very nearly by the equation $t = k_1 s^2 + k_2 s$, where $s$ is the linear distance moved by the interface in time $t$, and $k_1$ and $k_2$ are constants. The apparent energy of activation between 0° and 30° is of the order of 10000–11000 cal., which is very much less than the internal latent heats of sublimation of the two forms, which are of the orders 22000 (red) and 19000 (yellow) cal. The rate when $s = 0$ is about 1000 times greater than that calculated on the assumption that it is governed by the difference between the rates of evaporation of the two forms into a vacuum. At 130° (red → yellow) the reaction occurs mainly by the growth of nuclei of the yellow form in the interior of the film. In unannealed films, the linear rate shows a strong decline, owing presumably to the presence of cracks and possibly also to the loss of material from these cracks by evaporation. In annealed films, sealed to prevent evaporation, the rate is roughly constant in the early stages, but when the process is followed for a sufficient distance, the $s$–$t$ curve is sigmoid in shape. The rate varies considerably from film to film. AUTHORS.

**4766. Growth of Large Crystals of Potassium Bromide. K. Chamberlain.** *Rev. Sci. Instruments*, 9. *pp.* 322–324, *Oct.*, 1938.—

Details are given regarding the construction of a suitable furnace, and of the method adopted for the production of large crystals of KBr, up to 5 in. in dia. and weighing 6–7 lb., in 12 hr. C. A. S.

**4767. Crystal Growth of NaCl. K. Spangenberg.** *Zeits. f. Krist.* 100. 1. *pp.* 82–85, 1938.—The growth of NaCl crystals is studied under carefully controlled conditions, the temperature being kept constant to $\pm 0{\cdot}001°$ C. The observations indicate that there are two types of crystals, the characteristics of which are described. C. J. B. C.

*See also* Abstracts **4753**, **4771**, **4942**, **4982**, **4999**, **5061** and **3367B**. Graphical Representation of the Lever Law in Heterogeneous Equilibria. R. Bertschinger.

## DENSITY.

**4768. Density of Glass by the Additive Rule. P. Bary and J. Herbert.** *Comptes Rendus*, 207. *pp.* 627–629, *Oct.* 10, 1938.—The rule of addition of volumes applied to the components of a glass leads to a value for the density which may be in error by 15%. On the hypothesis that glass may be considered as a gel composed of alkaline silicates dissolved in polysilicates of alkaline-earths, it is concluded that the silica is present in two forms. On assigning to each of these its correct density, it is found that the calculated densities of various glasses agree with the measured values to within about 1%. For glasses containing a large proportion of alumina it is found necessary to assume the density of the alumina to be 2·60, and it is concluded that the alumina is present as aluminium silicate and not in the colloidal state. W. H. Wal.

*See also* Abstracts **4820**, **4931**.

## DIFFUSION AND OSMOSIS.

**4769. Diffusion of He and $H_2$ through Pyrex Glass. N. W. Taylor and W. Rast.** *J. Chem. Phys.* 6. *pp.* 612–619, *Oct.*, 1938.—The effects of temperature and of heat treatment on pyrex glass were studied by measuring the rate of diffusion of He at 180° to 590° and of $H_2$ at 512° through a tube of about 1 mm. wall thickness. The diffusion rate was found to be proportional to the pressure for both gases. A discussion of diffusion data throws light on the processes of molecular rearrangement involved in stabilisation of the glass. A continuous linear dependence for the stabilised glass of log R (diffusion rate) on $1/T$ from 440° to 590° is shown, and it follows that the properties of a stabilised glass are continuous with those of a viscous liquid, the so-called transformation point being merely the temperature of rapid strain release of an unannealed sample. Near 440° there is evidence of the loss of rotational or vibrational freedom in the silicate complex, analogous to that frequently found in dielectric studies on solids. Activation energies are calculated for the two temperature ranges. At 512° the rate of He diffusion is about 45 times that of $H_2$, and it is believed that chemical forces delay the progress of the $H_2$ molecule through the silicate network. The general conclusion is drawn that gas diffusion furnishes a highly senstive method of studying the molecular condition of silicate glasses and similar materials. N. M. B.

**4770. Interpretation of Diffusion Data for Strong Electrolytes. P. van Rysselberghe.** *Am. Chem. Soc., J.* 60 *pp.* 2326–2331, *Oct.*, 1938.—The diffusion mobilities of KCl, NaCl and $KNO_3$ in aqueous solution are calculated from the experimental diffusion coefficients and the thermodynamic factors $1+C\partial\log f / \partial C$. The diffusion mobilities are com-

pared with theoretical values obtained in three different manners: (*a*) by means of the Onsager-Fuoss theory of diffusion; (*b*) by applying the simple viscosity correction to the mobility at infinite dilution; (*c*) by applying the viscosity correction to the Onsager-Fuoss mobilities. It is shown that the viscosity correction is at least as important as the Onsager-Fuoss interionic effects and that, with sodium chloride, the correct sign for the variation of the mobility cannot be obtained without the viscosity correction. Remarks are made concerning the minima in the diffusion and activity-coefficient curves and concerning the diffusion of sucrose. A modified form of the Stokes-Einstein law of diffusion is proposed. AUTHOR.

**4771. Diffusion of Water in Crystals. H. Kraft.** *Zeits. f. Physik*, 110. 5–6. *pp.* 303–309, 1938.—The diffusion of water in a crystal having water of crystallisation is measured. The method of experimenting is to allow $D_2O$ to diffuse into crystals which have $H_2O$ of crystallisation, and to measure the $D_2O$ content spectroscopically. The diffusion coefficient is very small; $1{\cdot}0 \times 10^{-11}$ cm.$^2$/sec. at 75°C, $7{\cdot}5 \times 10^{-12}$ at 65°C. and $5{\cdot}9 \times 10^{-12}$ at 55°C. in alum. From the temperature coefficient of the diffusion speed the activation energy is calculated as 6000 cal. C. J. B. C.

***4772. Porous Diaphragm Method of Measuring Diffusion Velocity, and Velocity of Diffusion of KCl in Water. G. S. Hartley and D. F. Runnicles.** *Roy. Soc., Proc.* 168A. *pp.* 401–419, *Nov.* 7, 1938.—A continuous reading apparatus for measuring the rates of diffusion of pure electrolytes through porous diaphragms is described. Data obtained for the diffusion of KCl as a function of concentration are presented and the absolute values obtained by extrapolation. The comparison of the results obtained with the best available data by absolute measurements shows that there is still room for more accurate work in the whole problem, but it is believed that the diffusion coefficients in the range from $N/100$ to $N/10$ are accurate to within 2%. [See following Abstract.] AUTHORS.

**4773. Size of Paraffin-Chain Salt Micelles from Diffusion Measurements. G. S. Hartley and D. F. Runnicles.** *Roy. Soc., Proc.* 168A. *pp.* 420–440, *Nov.* 7, 1938.—The porous diaphragm method has been applied to the measurement of the diffusion of paraffin-chain micelles in aqueous solution with a swamping excess of simple electrolyte. For cetyl pyridinium salts the method is satisfactory and a radius for the micelle of about 26Å is found. The radius is independent, within experimental error, of the concentration of paraffin chain or swamping electrolyte, and very little dependent on temperature. These results are in excellent agreement with the "spherical liquid micelle" theory. There is small, but definite, influence of the nature of the gegenion on the size of the micelle. For cetane sulphonates and cetyl sulphates the method fails to give reliable results, probably owing to the building up of a structure within the pores of the diaphragm. When the solutions are saturated with amyl alcohol or benzene the method again fails to give reliable results. A mechanism is suggested for the anomalies observed. [See preceding Abstract.] AUTHORS.

**4774. Boundary Layer at Membrane and Monolayer Interfaces. J. H. Schulman and T. Teorell.** *Faraday Soc., Trans.* 34. *pp.* 1337–1341, *Nov.*, 1938.—By a new technique of flowing monolayers over aqueous solutions of different viscosities, an apparent boundary layer of 0·03 mm.

thick was determined. The thickness of this layer varied with the viscosity of the underlying solution, but contrary to experience at discrete boundaries the thickness did not vary with the velocity of the monolayer. An explanation was offered for this phenomenon in that the molecular density of the film alters with its velocity such that the number of molecules per unit area × the rate of flow remained constant. By application of Fick's diffusion equation for H- ions diffusing through cellophane membranes in a stirred solution, an apparent unstirred boundary layer of similar dimensions of 0·03 mm. with the proceeding experiment was obtained. The effect of unstirred diffusion layers was eliminated by buffering the H- ions by means of gelatin immediately upon their leaving the membrane. The importance of unstirred boundary layers when considering diffusion in biological systems is pointed out. AUTHORS.

*See also* Abstract 4994.

## ELASTICITY AND PLASTICITY.

**4775. Finite Strains : Dislocation Solutions. S. T. Newing and W. M. Shepherd.** *Phil. Mag.* 26. *pp.* 557–569, *Oct.*, 1938.—A mathematical study of the consequences of the distortion of a uniform circular cylindrical sheet of elastic material for two cases, (1) in which a longitudinal strip is removed, and the edges then brought together, and (2) in which a longitudinal cut is made, and the edges forced apart. In a detailed analysis of a special instance of (1) it is found that according to the finite strain theory used in this paper [see Abstract 3452 (1936)] the couple required to produce a given decrease in the curvature of an already curved plate is less than that deduced from the small strain theory. J. P. A.

**4776. Relaxation Methods Applied to Engineering Problems. Part III. Problems Involving Two Independent Variables. D. G. Christopherson and R. V. Southwell.** *Roy. Soc., Proc.* 168A. *pp.* 317–350, *Nov.* 7, 1938.—In this paper relaxation methods are applied with success to four problems involving Laplace's, Poisson's and similar equations in *two variables*, namely : The torsion problem of Saint-Venant for triangular shafts (this, since the solution is known, serves to illustrate and in some degree to test the methods) ; the same problem for a shaft pierced by axial holes (a multiply-connected cross-section) ; the torsion problem modified by the imposition of a definite limit to the shear stress (Prandtl's problem) ; the problem of magnetic induction in a field containing iron. In all four problems the methods lead without difficulty to solutions of sufficient accuracy for practical purposes, and it seems reasonable to conclude that they will be applicable (suitably modified) to other problems which, like the last three, would present great or insuperable difficulties if treated by orthodox methods. [For Part II see Abstract 946 (1938).] AUTHORS.

**4777. Stresses in a Heavy Disc Suspended from an Eccentric Peg. R. D. Mindlin.** *J. of Applied Physics*, 9. *pp.* 714–717, *Nov.*, 1938. *Phil. Mag.* 26. *pp.* 713–719, *Nov.*, 1938.—An exact solution of the two-dimensional elasticity equations for small strain is obtained which satisfies the boundary conditions for a heavy disc suspended in a vertical plane from an eccentric peg of small diameter. AUTHOR.

***4778. Standard Discs in Strain Testing of Glassware. E. J. Gooding.** *Soc. Glass Technol. J.* 22. *pp.* 243–249, *Aug.*, 1938.—By comparison with standard glass discs strained to a controlled amount

glassware has been graded for degree of temper. The methods used in the preparation, calibration, and use of the discs are described and their usefulness assessed. AUTHOR.

**4779. Dependence of Mechanical Strength of Quartz Glass on Temperature. W. Dawihl and W. Rix.** *Zeits. f. techn. Physik*, 19. 10. *pp.* 294–296, 1938.—Measurements of the strength of quartz rods and of hollow specimens made from quartz glass show that the resistance of quartz glass to mechanical stress is a third greater at 800°C. than at room-temperature. The formation of mirror faces at each temperature is in agreement with the views of Smekal. J. T.

*See also* Abstracts 4792, 4829, 4974 and
3620B. Damping of Forced Oscillations. E. Lehr and A. Weigand.

## GRAVITATION.

***4780. Precise Measurement of "g." A. Guillet.** *Comptes Rendus*, 207. *pp.* 614–616, *Oct.* 10, 1938.—A Newton tube is used in which a weight is released by an electromagnet and falls vertically. The time employed in falling to a lower level is determined either by electrical recording or by a camera falling at the same time as the weight and photographing it against a scale. The distance between the two fixed points is determined by means of a comparator. Pressure and temperature in the tube are measured. The degree of accuracy for different times and distances is very high. R. S. R.

## HYDRODYNAMICS AND AERODYNAMICS.

**4781. Approximate Prediction of Skin Friction and Lift. N. A. V. Piercy, J. H. Preston and L. G. Whitehead.** *Phil. Mag.* 26. *pp.* 791–815, *Nov.*, 1938. *Supplement.*—[See also Abstract 2541 (1936).]

**4782. Mean Value of Fluctuations in Pressure and Pressure-Gradient in a Turbulent Fluid. A. E. Green.** *Cambridge Phil. Soc., Proc.* 34. *pp.* 534–539, *Oct.*, 1938.—Taylor has shown that two characteristic lengths, $\lambda$ and $\lambda_\eta$ can be defined for turbulent fluid motion [see Abstract 4101 (1935)] such that $\lambda^2/\lambda_\eta^2 = 9\,\beta^2/2$, where $\beta$ is a constant, the turbulence being assumed to be isotropic. He obtained a value $0{\cdot}694$ for $\lambda_\eta/\lambda$, which he compared with an observed value $\lambda_\eta/\lambda = 0{\cdot}5$ [see Abstract 3996 (1936)]. Hall has recently obtained an experimental value $1{\cdot}6$ for $\lambda_\eta/\lambda$. Considering four fairly simple representations of motions which may be regarded as approximations to isotropic motions, the author deduces theoretical values of $\lambda_\eta/\lambda$ ranging from $0{\cdot}86$ to $1{\cdot}02$. J. S. G. T.

**4783. Oscillatory Motion of a Fluid along a Circular Tube. D. G. Christopherson, A. Gemant, A. H. A. Hogg and R. V. Southwell.** *Roy. Soc., Proc.* 168*A*. *pp.* 351–378, *Nov.* 7, 1938.—This paper is concerned with oscillatory motion (either free or forced) of a viscous fluid along a circular tube : the restoring force comes in both instances from the "gravity head" which results from the passage of fluid. Part I is a theoretical discussion of the problem. Part II deals from a practical standpoint with complicating factors (*e.g.*, turbulence, or meniscus and other end effects) which the theory does not take into account, and briefly discusses a possible application to viscometry. Part III gives the results of experiments made to test the predictions of Parts I and II. AUTHORS.

*See also* Abstracts 4787, 4803.

## KINETIC THEORY OF MATTER.

*See* Abstract 4994.

## LENGTH, AREA AND VOLUME.

***4784. Deformation of Sensitive Levers. Berndt and W. Vogt.** *Zeits. f. Instrumentenk.* 58. *pp.* 389–408, *Oct.*, 1938.—The authors discuss the deformations which tend to falsify the measurements made with various types of lever. Such deformations are principally of three kinds : (1) Hooke's law compression due to forces uniformly distributed over the cross-section ; (2) Hertzian flattening of curved surfaces ; (3) Bending, resulting in variation of the distance from the support. These effects are thoroughly investigated for six different types of levers comprising (*a*) simple optical lever, (*b*) simple mechanical lever, (*c*) double mechanical lever with one lever working on another, (*d*) double mechanical lever with one lever working on a geared drive, (*e*) meter mechanism with spur-wheel or worm and wheel drive, (*f*) torsion and electric levers. The results obtained are tabulated and discussed. A. W.

***4785. Curved Rulers. F. Emde.** *Zeits. f. Instrumentenk.* 58. *pp.* 409–411, *Oct.*, 1938.—With curves of slowly varying curvature a useful method of representation is a series of circular arcs, since at any point a fairly long portion of the curve nearly coincides with an arc of a circle of some definite radius. When the curvature varies rapidly, a knowledge is required of the radii of curvature at a series of points along the curve, together with the rate of change of the radius. Assuming, as is usually the case, that only the convex edge of the ruler is used and that the radius continually increases, a spiral of some sort is obtained. It appears very desirable that this should conform to some simple equation. Typical forms are the logarithmic spiral and Cornu's spiral. The properties of these are briefly discussed and three illustrations are given of curved rulers based on what is called the " sici " spiral. A point on this curve is defined by the relation $x + iy = -\mathrm{L}\int_{\varrho}^{\infty} \frac{e^{i\varrho}}{\phi}\, d\phi = \mathrm{L}\,\mathrm{ci}\,\phi + i\,\mathrm{L}\,\mathrm{si}\,\phi$, where the functions ci and si denote the integral cosine and integral sine respectively. The values of these functions can readily be obtained from Jahnke-Emde tables and hence curves of any required length and curvature variation can quickly be drawn, using the relations $\phi = \mathrm{L}/\mathrm{R}$, $x = \mathrm{L}\,\mathrm{ci}\,\phi$ and $y = \mathrm{L}\,\mathrm{si}\,\phi$. Such curves have been in use for a considerable time and have proved extremely useful. A. W.

***4786. Calibration of Circular Scales from Eccentricity Measurements. W. Krug.** *Zeits. f. Instrumentenk.* 58. *pp.* 412–416, *Oct.*, 1938.—Comparison of results obtained using Uhink's method of eccentricity measurements with those given by Förster's method shows that the eccentricity method gives in practice curves which are sufficiently accurate to determine considerable errors in circular division. A. W.

***4787. Differential Pneumatic Micrometer. G. Ribaud.** *Comptes Rendus*, 207. *pp.* 618–619, *Oct.* 10, 1938.—Describes a modification of the pneumatic micrometer, used in the control of orifices for flow measurement, in which the differential principle is applied in order to increase the sensitivity and precision. This allows the instrument to be used for measuring variations of thickness, or even small displacements down to less than

$0 \cdot 1\mu$. It is pointed out that the principle employed has certain analogies with that of the Wheatstone bridge. H. B.

*See also* Abstract 5044 and
3426B. Elongation Measuring Apparatus. A. Thum, O. Svenson and H. Weiss.

## MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

**4788. Functions of Quaternions. V. C. A. Ferraro.** *Roy. Irish Acad., Proc.* 44. *pp.* 101–108, *Jan.*, 1938.

**4789. Method of Calculating Fluctuations. R. Ellickson.** *Phys. Rev.* 54. *pp.* 572–579, *Oct.* 15, 1938.—A general method for the solution of fluctuation problems is described. A generating function for the differential equations that are satisfied by the probabilities in question is defined and the problem is reduced to the determination of the generating function. The general method for its determination is given and the results are applied to fluctuation problems in pair-production and radioactive disintegration. The method of finding the mean, mean square, and standard deviation from the generating function without reference to the form of the distribution itself is applied to the examples. The problem of fluctuations in chain and branch radioactive disintegrations is solved without restrictions on the size of the disintegration constants involved. Author.

**4790. Problem in Coin-Tosses. S. R. Savur.** *Phys. Soc., Proc.* 50. *pp.* 947–954, *Disc.*, 954–960, *Nov.* 1, 1938.—The paper discusses data given by Campbell [see Abstract 3768 (1935)] on the tossing of a coin, and questions his conclusion that the particular series quoted does not define a chance. A theoretical investigation is made of the limits within which the heads-to-tails ratio obtained by tossing a coin a given number of times may be expected to diverge from unity, and a practical study of the drawing of coloured balls from a container is described. The conclusion reached is that the ratio obtained in practice converges toward the ratio to be expected on theoretical grounds provided that the number of trials is very great indeed. Author.

***4791. Equation Solver. D. L. Herr and R. S. Graham.** *Rev. Sci. Instruments*, 9. *pp.* 310–314, *Oct.*, 1938.—Describes the mechanical details of the construction of a machine which will give all the roots of an algebraic equation of the eighth degree or less having real coefficients. A simple extension to the machine will permit the solution of equations with complex coefficients of any degree. The paper gives the mathematical theory on which the design of the machine is based and the equations to the various cams for controlling the potentiometers. H. H. H.

*See also* Abstracts 4776, 4784, 4786, 4795, 4796, 4804, 4843, 4861 and
3386B. Application of Fourier Integral. P. David.

## MECHANICS, CLASSICAL.

**4792. Relations between Energy Theorems Applicable in Structural Theory. D. Williams.** *Phil. Mag.* 26. *pp.* 617–635, *Nov.*, 1938.—The purpose of this article is to set out the relationships linking the various energy theorems applicable to structural problems, and to comment on their respective uses and limitations. Certain relevant proofs that may be of interest are added in an appendix. Author.

**4793. General Problem of Exterior Ballistics. G. Garcia.** *Comptes Rendus*, 207. *pp.* 524–526, *Sept.* 26, 1938.—The problem is

treated vectorially. A solution of the equation of motion is obtained by successive approximation. S. W.

**4794. Impact of Falling Mass on an Elastic Rectilinear Prism. L. Bergeron.** *Comptes Rendus*, 207. *pp.* 665–667, *Oct.* 17, 1938.—A simple graphical method of discussing the impact of a falling mass upon an elastic rectilinear prism is presented; the method indicates that results obtained by Saint-Venant and by Boussinesq require amendment and can be extended. J. S. G. T.

**4795. General Equation of Statistical Mechanics. B. Hostinský.** *Comptes Rendus*, 207. *pp.* 522–524, *Sept.* 26, 1938.—The instantaneous configuration of a mechanical system is given by Lagrangian coordinates and components of speed. An expression is obtained for the probability of travel in terms of the relative probability of quick change of some coordinates. The expression is simplified by successive approximations. R. S. R.

*4796. **Mechanical Calculation of Surface Moments. F. Lorenz.** *Zeits. f. Instrumentenk.* 58. *pp.* 448–452, *Nov.*, 1938.—A description is given of the construction and method of operation of an instrument used to determine in a mechanical way the surface moments of any plane figure in reference to any selected axis. The method of working is based on a new theory which holds in a general way for the full series of surface moments. R. S. R.

*See also* Abstracts 4777, 4819.

## MECHANICS, QUANTUM.

**4797. Field Theory of the Atom. H. Takeno.** *Hirosima Journ. Sci.* 8. *pp.* 271–288, *Aug.*, 1938. *In English.*—Solutions are deduced for various expressions previously found [see Abstract 1838 (1938)] for conditions of integrability of the fundamental equation of the Mimura-Morinaja wave geometry as applied to the field theory of the atom. N. M. B.

**4798. Proper Transverse Energy of the Electron. G. Beck.** *Comptes Rendus*, 207. *pp.* 528–530, *Sept.* 26, 1938.—Quantum electrodynamics leads to two terms for the proper energy of an electron in interaction with an electromagnetic field : longitudinal energy corresponding to the proper energy of the Coulomb field, and transverse energy due to interaction with the radiation field. The latter energy, a purely quantum phenomenon not hitherto interpreted physically, is shown mathematically to be explained, for a Dirac electron, as the energy of the magnetic field produced by the electron spin. Virtual transitions towards negative energy states do not correspond to a real phenomenon and must be excluded as are analogous transition in the Dirac theory of "holes." N. M. B.

**4799. Theory of Electron Spin. W. Wessel.** *Zeits. f. Physik*, 110. 9–10. *pp.* 625–660, 1938.—An attempt is made to construct a theory in which the spin appears as a consequence of the radiative reaction force. R. P.

**4800. Concept of a Discrete Space-Structure. A. March.** *Naturwiss.* 26. *pp.* 649–656, *Oct.* 7, 1938.—A general account is given of the theories proposed by Flint, March and Mimura based on the concept that points lying within a sphere of radius $l_0$, centred at any point $P$, are indistinguishable from $P$. This leads to a statistical interpretation of the meaning of distance and can also be applied to the description of a particle

as something of the nature of an "extended" body and not as a geometrical point. It can also be proved that radiation of wave-length $\leq 2\ l_o$ cannot interact with a closed material system. It is shown how the value of $l_o$ might be determined from the energy-loss of cosmic rays as they penetrate matter. The significance of this discrete space-structure in nuclear physics is also discussed. The principal result is that $\beta$-decay cannot create electrons whose de Broglie wave-length, measured in coordinates relative to the centre of gravity, is less than $2\ l_o$. G. C. McV.

**4801. Wave Functions for $Na^-$ and $K^-$. D. R. Hartree and W. Hartree.** *Cambridge Phil. Soc., Proc.* 34. *pp.* 550–558, *Oct.*, 1938.—Solutions of Fock's equation for the self-consistent field with exchange have been carried out for the negative ions $Na^-$, $K^-$. The results indicate that these negative ions can certainly exist; and calculations of the energy values, and estimates of the errors of these values, indicate that these ions are probably stable and not liable to autoionisation. The wave functions for these negative ions are required in calculating atomic cross-sections for the capture of electrons by the neutral atoms. AUTHORS.

**4802. Calculation of Coulomb Wave Functions for High Energies. L. E. Hoisington and G. Breit.** *Phys. Rev.* 54. *pp.* 627–628, *Oct.* 15, 1938.—For high energies and moderate radii Coulomb functions are conveniently calculated by evaluating certain integrals numerically. [See also Abstract **64** (1938).] AUTHORS.

*See also* Abstracts **4736, 4737, 4939, 4993, 4997.**

## PRESSURE.

***4803. Liquid Flow in Tubes and Suction Pumps. G. Heinrich.** *Akad. Wiss. Wien, Ber.* 147. 2*a*. 1–2. *pp.* 1–28, 1938.—In a previous paper [see Abstract 5415 (1936)] the author has obtained experimentally curves showing the pressure distribution along the diffusor of a water-jet suction pump for different degrees of vacuum in the attached vessel. There is a sharp fall in pressure at a point which, as the degree of evacuation is increased, moves inwards along the diffusor. The position of this point is independent of the size of the bore of the diffusor and it is supposed that the water enters the tube as a free stream but suddenly enlarges its cross-section at this particular point and then runs on as a stream touching the walls of the tube. This kind of flow is investigated mathematically and formulae for the position along the tube where the enlargement of the jet takes place are derived and discussed. The stability of flow at this point is also investigated and it is shown that for large tubes the flow is stable, for narrow tubes unstable, results which are in agreement with experiment. The author applies his results to the flow of water in the suction pipes of a turbine and they lead to a qualitative explanation of the experimental work of V. Kaplan. Finally the air suction and the sudden compression of the air as it passes the place of greatest pressure gradient are considered. Formulae and diagrams are given showing the effect the sudden compression has on the action of the water-jet pump. S. W.

*See also* Abstract 4998.

## RELATIVITY AND ETHER.

**4804. Spinor Calculus. T. Sibata.** *Hirosima Journ. Sci.* 8. *pp.* 169–186, *Aug.*, 1938. *In English.*—The real vectors and tensors which can be formed out of a spinor and a set of matrices $\gamma_i$ which satisfy

$\gamma_i\gamma_j + \gamma_j\gamma_i = g_{ij}$ where $g_{ij}$ is a fundamental tensor, are discussed. Those invariant for spin-transformation are defined and the relations existing between them are investigated. G. C. McV.

**4805. Equation of Motion of a Particle in Wave Geometry. T. Iwatsuki, Y. Mimura and T. Sibata.** *Hirosima Journ. Sci.* 8. *pp.* 187–192, *Aug.*, 1938. *In English.*—The fundamental spinor $\psi$ of the author's wave geometry satisfies a fundamental equation. It is now shown that a certain vector $(u^k)$ formed out of $\psi$ and the matrices $\gamma_i$, where $\gamma_i\gamma_j + \gamma_j\gamma_i = g_{ij}$ [$g_{ij}$ is the metrical tensor], is the tangent vector to a geodesic of the space. [See following Abstract.] G. C. McV.

**4806. Cosmology in Terms of Wave Geometry. Part I. Y. Mimura and T. Iwatsuki.** *Hirosima Journ. Sci.* 8. *pp.* 193–197, *Aug.*, 1938. *In English.*—The vector $u^k$ defined in a previous paper [see preceding Abstract] may be interpreted as the momentum density vector of a moving particle the latter, in cosmological applications of the theory, being regarded as a nebula. The equations which $u^k$ must satisfy, however, restrict space-time to be either that of the Einstein universe or of the de Sitter universe. [See following Abstract.] G. C. McV.

**4807. Cosmology in Terms of Wave Geometry. Part II. T. Sibata.** *Hirosima Journ. Sci.* 8. *pp.* 199–223, *Aug.*, 1938. *In English.*—The paper contains a detailed proof of the foregoing restriction on the metric of space-time. [See preceding Abstract.] G. C. McV.

**4808. Cosmology in Terms of Wave Geometry. Part III. H. Takeno.** *Hirosima Journ. Sci.* 8. *pp.* 223–237, *Aug.*, 1938. *In English.*—The explicit expressions for the vector $u^k$ in terms of the coordinates is calculated for the de Sitter and the Einstein case respectively. [See preceding Abstract.] G. C. McV.

**4809. Cosmology in Terms of Wave Geometry. Part IV. K. Itimaru.** *Hirosima Journ. Sci.* 8. *pp.* 239–248, *Aug.*, 1938. *In English.*—The values of $u^k$ [see preceding Abstract] in terms of the coordinates show that a motion of recession is possible only in the de Sitter case. It follows, however, that the total mass of matter in this universe (as defined on the basis of the vector $u^k$) increases with the time, although the mass of each individual particle of matter remains constant. G. C. McV.

**4810. Finslerian Wave Geometry and Milne's World Structure. T. Hosokawa.** *Hirosima Journ. Sci.* 8. *pp.* 249–270, *Aug.*, 1938. *In English.*—A number of theorems are worked out in Finsler geometry including the condition that two Finslerian manifolds should have the same geodesics as well as the analogues of the equations of Killing giving the group of motions of the manifold into istelf. The fundamental quadratic form for a Finsler space admitting the Lorentz group is deduced. A " wave geometry " is then constructed for Finsler space based on the idea of the " linearisation " of the expression for the interval between two neighbouring points. G. C. McV.

*See also* Abstracts **4797, 4800.**

## SOLUTION.

**4811. Absorption of $H_2$ and $N_2$ by Pure Fe. K. Iwasè and M. Fukusima.** *Tôhoku Univ., Sci. Reports*, 27. *pp.* 162–188, *Sept.*, 1938. *In English.*—The amounts of $H_2$ and $N_2$ observed in pure Fe at various high

temperatures are volumetrically determined. Electrolytic Fe and reduced Fe, thoroughly reduced by treating them several times with dry $H_2$ at 1250° were used. The results obtained are in good agreement with those found in literature. AUTHORS.

**4812. Solubility of $H_2$, $D_2$, and $N_2$ in Fe. A. Sieverts, G. Zapf and H. Moritz.** *Zeits. f. phys. Chem.* 183. *Abt.A.*1. *pp.* 19–37, 1938.—Previous work is critically reviewed and compared with the authors' experimental data. For solubility of $H_2$ in cm.$^3$ per 100 gm. Fe, the following values are reported, the mean of established values being given in brackets: At 500° C. 0·6 (0·7), at 700° C. 1·8 (1·7), at 900° C. (*A*3) 3·0 for $\alpha$ (2·9), 4·7 for $\gamma$ (4·5), at 1100° C. 7·0 (6·6), at 1200° C. 8·2 (7·7), at 1250° C. 8·2 (7·7), at 1350° C. 10·1 (10·5), at 1400° C. (*A*4) 10·5 for $\gamma$, 10·1 for $\alpha$, at 1450° C. 11·0 (12·0), at 1520° C. (m.pt.) 14 for $\alpha$ (13), 25 for liquid (26), at 1550° C. 26 (28), at 1650° C. (31). Values were determined with ingot iron, carbonyl iron and electrolytic iron. By difference measurements, the solubility of $D_2$ is deduced and found to be consistently lower than that of $H_2$, about 10% between 500° and 1200° C. Their behaviour is generally similar with Fe, in contrast to that with Pd. For solubility of $N_2$ in Fe the following figures were obtained at 754 mm:—at 1200° C. 19·2, at 1300° C. 18·2, at 1400° C. 13·9, at 1450° C. 9·3, at 1390° C. 17·2. Qualitatively the solubility diagrams show much similarity with $H_2$ and $N_2$,—increase of solubility on the $\alpha \rightarrow \gamma$ (and $\delta \rightarrow \gamma$) changes, and on melting, but with $H_2$ the solubility rises with temperature, while with $N_2$ it falls. The latter phenomenon is rare with metal-gas solutions without compound formation, *e.g.*, in Pd-$H_2$, Mn-$H_2$. D. R. H.

**4813. Solubility of Slightly Soluble Silver Salts. C. Bedel.** *Comptes Rendus*, 207. *pp.* 633–634, *Oct.* 10, 1938.—The solubility of AgBr in presence of the soluble compound produced when it is precipitated is scarcely affected when that product is $KNO_3$, $LiNO_3$, $Ba(NO_3)_2$, $Mn(NO_3)_2$, $HNO_3$ or $H_2SO_4$; but it is greatly increased if this be $Hg(NO_3)_2$, or (to a less extent) $HgSO_4$, indicating formation of some combination between AgBr and the Hg salt. The solubility of AgI varies little under similar circumstances, being approximately $4·60 \times 10^{-5}$ gm./l. The increases in solubility with temperature of AgCl, AgBr and AgI are also given. C. A. S.

**4814. Distribution of Minute Amounts of Material between Liquid Phases. D. C. Grahame and G. T. Seaborg.** *Am. Chem. Soc., J.* 60. *pp.* 2524–2528, *Oct.*, 1938.—The distribution of minute quantities (*ca.* $10^{-12}$ — $10^{-15}$ gm.) of soluble substances between liquid phases is shown in the cases studied to be quantitatively the same as that observed for the same substances in ordinary small concentrations. Distribution ratios of several metallic halides between ether and hydrochloric acid are determined at low concentrations by the use of radioactive substances. It is shown that the technique here employed may be of use in separating and identifying artificially prepared radioactive substances without the use of a non-radioactive carrier. AUTHORS.

*See also* Abstract 5004.

## SURFACE PROPERTIES.

**4815. Theory of Adsorption when Each Particle Occupies more than One Site. J. K. Roberts.** *Cambridge Phil. Soc., Proc.* 34. *pp.* 577–586, *Oct.*, 1938.—In order to be able to identify the type to which an adsorbed film belongs from its experimentally determined behaviour, it is necessary to know theoretically how various simple and general types,

which are likely to occur frequently, behave. Films formed on a rectangular solid lattice with another atom at the centre of each rectangle are considered. Each adsorbed molecule is assumed sufficiently large to exclude the possibility of adsorption on the four neighbouring sites and, owing to the rectangular shape of the lattice, reacts appreciably with two and not with four neighbouring adsorbed molecules. The statistics and kinetics of the film are considered. It is shown that the variation of heat of adsorption with fraction of sites occupied is quite different from that of other types of film which have so far been treated. Immobile films of the same type are briefly discussed. [See also Abstract 3546 (1938).] AUTHOR.

**4816. Electrical Factors in the Adsorption of Polar Molecules at the Surface of Solutions. R. DuBois and E. E. Todd.** *Am. Chem. Soc., J.* 60. *pp.* 2355–2359, *Oct.*, 1938.—Attention is called to the fact that the adsorption of solutes at the air-solution interface, when measured by dynamic methods (moving bubbles, etc.), is generally found to be several times greater than the values calculated from surface tension data by means of the Gibbs adsorption equations. In order to test the suggestion that the excessive observed adsorption is due to electrification of the moving surfaces, the authors have attempted to alter the adsorption of *p*-toluidine on moving bubbles by forced charging of the gas. Marked decrease in the apparent adsorption was observed when the gas was subjected to spark discharge and to silent discharge before entering the adsorption apparatus. Because of its persistence after discharge ceased the effect was believed to be of chemical origin. Ionisation of the bubbling gas by exposure to ionium salt was found to have no effect on the measured adsorption. The effect of a surface charge on the adsorption of polar molecules is discussed theoretically. Calculations show that the adsorption of *p*-toluidine on gas bubbles should be only slightly increased by electrification of the surface and at extreme charge densities should be somewhat decreased. It is concluded that electrification of gas bubbles in contact with solutions of organic solutes is not responsible for the marked discrepancy between the observed adsorption and the calculated " Gibbs " adsorption. AUTHORS.

**4817. Effects of Dipole Interactions on Heats of Adsorption. J. K. Roberts.** *Faraday Soc., Trans.* 34. *pp.* 1342–1346, *Nov.*, 1938.—The variation in heat of adsorption with fraction of surface covered is considered for the adsorption of vapours with a permanent dipole moment on conductors. Detailed calculations show that for typical molecules the effect of the dipole interaction and of the van der Waals attraction between adsorbed molecules are of the same order and, since they are opposite in sign, the net variation in heat of adsorption is small. In carrying out the calculations the mutual repulsions and depolarising effects of the dipoles and their electric images are taken into account. [See following Abstract.] AUTHOR.

**4818. Induced Dipoles and Heat of Adsorption of Argon on Ionic Crystals. J. K. Roberts and W. J. C. Orr.** *Faraday Soc., Trans.* 34. *pp.* 1346–1349, *Nov.*, 1938.—The electrostatic field at points equidistant from four ions near the surface of a 100 plane in a body-centred alkali-halide crystal is calculated. It is shown that, as in the case of permanent dipoles on conductors discussed in the previous paper [see preceding Abstract], the effect of the dipoles induced by this field in argon adsorbed on CsI makes the variation in heat of adsorption with fraction of surface covered considerably less than it would be if only van der Waals' forces were present. AUTHORS.

**4819. Relative Adsorbabilities of $H_2$ and $D_2$. A. Wheeler.** *J. Chem. Phys.* 6. *p.* 746, *Nov.*, 1938.—The unexpected results of Beebe, Klar and others on the relative adsorbabilities of $H_2$ and $D_2$ on metal surfaces are explained by a statistical-mechanical treatment. By constructing simple partitition functions for the adsorbed molecules and atoms, equal adsorption at low temperatures and an inversion temperature at higher temperatures are predicted. Both predictions are fulfilled by the experimental results. AUTHOR.

***4820. Measurement of Surface Tension and Density. E. Tyler.** *Am. Phys. Teacher*, 5. *pp.* 195–197, *Oct.*, 1937. *School Science Rev.* 20. *pp.* 41–48, *Oct.*, 1938.—Measurement of the apparent loss in weight (m) of either a partially immersed glass plate or hollow tube at varying depths (h) in water is made with the aid of a torsion balance. The linear relationship existing between (m) and (h) is confirmed by graphical representation. From a knowledge of the intercepts and the gradient of the resulting graph the coefficients of surface tension and density of the liquid are derived. The method is only applicable to liquids having zero angles of contact. AUTHOR.

**4821. Surface Tension and Internal Heat of Vaporisation. O. Albert and F. Eirich.** *Zeits. f. phys. Chem.* 183. *Abt. A.* 1. *pp.* 9–18, 1938.—The relation between the molecular surface energy $\mu_\sigma$ and the heat of vaporisation $l_i$ of nonylene-, nonyl-, and oleic acid esters was deduced with the aid of the data recently published by Albert. Extrapolation on the basis of molecular weights was necessary, but this was justified by the fact that the Stefan factors thus found are independent of temperature, and the heats of vaporisation are additive. The values of $l_i$ are as expected, and the values of $\mu_\sigma$ and $l_i/\mu_\sigma$ are explained on the basis of the Langmuir conception of molecular orientation in the surface layer. P. H. B.

**4822. Lowering of Surface Tension of Water by Electrolytes. J. J. Bikerman.** *Faraday Soc., Trans.* 34. *pp.* 1268–1274, *Nov.*, 1938.—A theory of the surface tension of electrolytic solutions is given. The work associated with an extension of the surface of solution consists of three parts, namely, (1) the work of bringing water molecules on to the surface; this term is independent of the concentration, (2) the work of compressing the ions into a smaller volume ; this " Wagner " term rises with the concentration, and (3) the work of separating positive and negative charges under the surface ; this term rapidly decreases with concentration. The combined effect of these terms produces a surface tension-concentration curve which agrees with experimental data of Jones and Ray. [See Abstract 1074 (1937).] AUTHOR.

**4823. Low-Temperature Oxidation of Iron. H. R. Nelson.** *J. Chem. Phys.* 6. *pp.* 606–611, *Oct.*, 1938.—An electron diffraction study of oxide films formed on Fe heated in air at 80-260°C. failed to detect any " critical temperature " near 200°C. Oxidation below 130°C. strengthened the pattern of the primary oxide film of $\gamma$-$Fe_2O_3$ or $Fe_3O_4$, whilst above this temperature $\alpha$-$Fe_2O_3$ was obtained provided a critical period of oxidation was exceeded. It is shown that the primary oxide film cannot be thicker than 200 Å. The appearance of the first-order blue interference colour at 193°C. coincided with the formation of a new type of $\alpha$-$Fe_2O_3$ film which was attributed to the outward diffusion of iron through the oxide layer. A. G. Q.

**4824. Flow and Viscosity of Monomolecular Films. M. Joly.** *J. de Physique et le Radium*, 9. *pp.* 345–351, *Sept.*, 1938.—The various theories dealing with this subject are described and the limits of their applicability discussed. The two-dimensional viscosity of a monomolecular film, and hence the viscosity per molecule, are calculated, the former being shown to be incomparably greater than the ordinary three-dimensional viscosity. [See Abstracts 496 and 996 (1938).] C. A. S.

**4825. Surface Viscosity of Long-Chain Alcohol Monolayers. L. Fourt and W. D. Harkins.** *J. Phys. Chem.* 42. *pp.* 897–910, *Oct.*, 1938.—Methods based on the damping of oscillating rings, discs, and vanes by a surface film give values of the surface viscosity which agree well enough to indicate the usefulness of such methods. A continuous rotation device, although not yet refined to the same degree of usefulness, gives similar values. Theory indicates that such a device would possess advantages for use with plastic films, and that it could be adapted to give absolute values of surface and interfacial film viscosities, free from subphase effects. The viscosity of expanded films of the normal alcohols is too low to measure by these means. Measurements were obtained on condensed films of the five alcohols from $C_{14}$ to $C_{18}$ inclusive. The low pressure linear part of the compression curve corresponds to low values of the surface viscosity, increasing more and more rapidly with increasing pressure. For this portion the longer the chain; the higher the viscosity. The high pressure linear part of the compression curve corresponds to high apparent viscosities, which are greater for lower rates of shear. These values, compared at a single average rate of shear, rise to a maximum as the pressure increases, then fall off with the approach of film collapse. Of the alcohols examined, only octa-decyl alcohol shows non-Newtonian viscosity below the kink point. The singular point or, as recent findings show, region of the force-area curves corresponds to the transition in viscosity. AUTHORS.

**4826. Increase in Viscosity of Mineral Oil at Rest. A. Marcelin.** *Comptes Rendus*, 207. *pp.* 616–618, *Oct.* 10, 1938.—The viscosity of a film of mineral oil was measured by the distance ($d$) traversed by a ball with fixed initial velocity along a horizontal groove covered with a film of such oil about 1 mm. thick; $d$ is approximately 25% greater, and the viscosity by so much less, when the oil has been recently placed on the groove, than it is when it has been standing several hours. In this latter case several repeated passages of the ball reduces the viscosity to its initial value. This is attributed to the molecules of oil being polarised on standing, but caused by repeated passages of the ball to take up positions inclined to the direction of, and so facilitating, the movement of the ball, whence they take time to recover. C. A. S.

**4827. Carrier Mobility Spectra of Liquids Electrified by Bubbling and Spraying. S. Chapman.** *Phys. Rev.* 54. *pp.* 520–533, *Oct.* 1, 1938.—The mobility spectra produced by bubbling water and various aqueous solutions of salt, acid, base, sugar, and soap were investigated with an Erikson mobility tube under high resolving power. Current-mobility curves show that for water there are two positive groups and fire negative groups of carriers having mobilities of 1·8 to 0·2 cm/sec. per V/cm. The ratio of the total amount of positive electrification to negative increases as the size of the bubbling capillary increases. Addition of salts to water favours production of slow carriers at the expense of fast ones. Medium concentrations ($10^{-3}$ molal) produce more

total electrification than distilled water, and high concentrations (1 molal) less. With the addition of sugar to water several groups of large numbers of carriers of various mobilities appear, and the total amount of electrification increases to about 12 times that for water. Air blasts of high humidity favour production of slow carriers and give heterogeneous spreads of mobilities. The group of negative carriers of mobility 1·8 produced by bubbling distilled water may be interpreted as consisting of a normal negative ion in moist air; the positive and negative groups at $+1{\cdot}0$ and $-0{\cdot}95$ appear to be due to carriers containing an extra $H^+$ and $OH^-$ ion, respectively. It is likely that the other distilled water groups are formed partly by the uniform breaking of the thin bubble film and partly by the evaporation of larger carriers. N. M. B.

*See also* Abstracts 4747, 4774, 5036, 5042, 5047, 5048.

## TIME.

***4828. New Schuler Clock. A. Scheibe.** *Zeits. f. Physik*, 110. 9–10. *p.* 660, 1938.—In the paper by H. Gockel and M. Schuler [see Abstract 3560 (1938)] the authors claimed that their pendulums had a logarithmic decrement lower than that of the best piezoelectric quartz resonators. It is now pointed out that, in fact, considerably lower values have been obtained by the vibrating quartz method. R. P.

## VISCOSITY AND FRICTION.

**4829. Rates of Displacement in Viscous Bodies under Applied Stress. R. W. Douglas.** *Soc. Glass Technol., J.* 22. *p.* 259, *Aug.*, 1938.—A correction to the original [see Abstract 3563 (1938)]. AUTHOR.

**4830. Viscosity of Dilute Solutions of Long-Chain Molecules. Part I. M. L. Huggins.** *J. Phys. Chem.* 42. *pp.* 911–919, *Oct.*, 1938.—By an extension of Kuhn's hydrodynamical treatment a theoretical equation has been derived relating the specific viscosity of a solution to the coordinates and dimensions of the atoms in the solute molecules. Applied to rod-like molecules this equation leads to proportionality (with $n$ large) between $\eta_{sp}/c$ and $n^2$. Applied to randomly kinked chain molecules, it leads to proportionality between $\eta_{sp}/c$ and $n$, the Staudinger relationship. Theoretical expressions have been obtained for the proportionality constant and also for the deviations for small values of $n$. Using a reasonable value for the "effective radius" of the $CH_2$ group, without any arbitrary constants whatever, the experimental data for solutions of paraffins are quantitatively accounted for. AUTHOR.

**4831. Viscosity of Aniline. L. A. Steiner.** *Indust. & Engin. Chem.* (*Analytical Edition*), 10. *pp.* 582–584, *Oct.* 15, 1938.—The viscosity of "chemically pure aniline," $d_4^{20} = 1{\cdot}0208 \pm 0{\cdot}0003$, was determined at 5° intervals from 20° to 100° C. within an error of $\pm 0{\cdot}20$ to $\pm 0{\cdot}30$ %. The measured viscosities were compared with the results in the literature, the latter being in part confirmed and in part found doubtful. The author's results, comprising the most accurate and complete data available for the viscosity of aniline, make possible calibration at 100° C. with the same accuracy as has been accepted with water at 20° C. In comparison with water, aniline as a calibration liquid has the advantages of higher viscosity, much lower surface tension, and applicability at high temperatures. AUTHOR.

**4832. Viscosity of Starch Pastes. J. R. Katz, M. C. Desai and J. Seiberlich.** *Faraday Soc., Trans.* 34. *pp.* 1258–1268, *Nov.*, 1938.—It was found that a starch paste is not at all comparable with a colloidal solution or a colloidal gel. When heated or mechanically treated, the thin vesicle walls break. They break much more readily under mechanical treatment on heating than at room-temperature or at 0° C. Instead of being plastic, the vesicle walls at lower temperature have become elastic. This same fact is responsible for the setting of starch puddings. Even in 1% starch pastes there is no proportionality between viscosity and concentration. The microscopical picture is too complicated for such a simple proportionality. In the same way, there is no reason to expect that (even for 1% pastes) the viscosity is independent of the pressure under which it flows. The factor which probably contributes most to the complexity of the system is the relatively small amount of free water between the vesicles. In concentrated starch pastes this water almost vanishes (or shrinks to a small amount). The viscosity (especially at the maximum, but probably all along the viscosity curves) is due, not only to a flow of water, made somewhat more difficult by the suspension in the water of a large amount of starch vesicles, but also to the rubbing of these vesicles against one another. This has to be taken into account as an essential part of the viscosity. AUTHORS.

*See also* Abstracts 4825, 4994.

# ASTRONOMY AND ASTROPHYSICS.

## ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***4833. Half-Filter Method of Photographic Photometry of Stars. O. Heckmann and H. Kienle.** *Göttingen Nachrichten, Fachgruppe II.* 2. 17. *pp.* 203–215, 1937.—Describes a modified form of the Kapteyn-Schwarzschild half-screen method of stellar photometry [see Abstract 505 (1933)] in which the wire screen is replaced by a neutral filter made by kathodic sputtering of Pt. The theory of the method is described in detail. J. W. T. W.

## COMETS AND METEORS.

**4834. Motion of Periodic Comet Kopff (1906e). F. Kępiński.** *Acad. Polonaise Sci. et Lettres, Bull.* 3-5*A*. *pp.* 179–202, *March–May*, 1938. *In English.*

## COSMOGONY.

*See* Abstracts 4805, 4806, 4807, 4808, 4809, 4810.

## DYNAMICAL PROBLEMS (ASTRONOMICAL).

**4835. Motion of Apsidal Line in Close Binary Systems. T. G. Cowling.** *Roy. Astron. Soc., M.N.* 98. *pp.* 734–744, *Oct.*, 1938. *Supplement.* It is pointed out that the discussions of the motion of the apse-line in binary stars given by Russell, Walter and Kopal [see Abstract 2754 (1938)] all depend to a smaller or greater extent on an assumption that the stars can be regarded as rigid during the motion. When regard is paid to the

fact that the stars are not rigid, a formula for the rate of advance of periastron is obtained, similar to Russell's, but differing in the numerical factor attached to certain of the terms. The density-concentrations of the stars which are deduced frrom the new formula are far more closely in agreement with Eddington's theory than those found by Russell. It is also noted that the librations of non-rigid stars are far more rapid than those of rigid stars: in consequence, the results regarding the density distribution derived by Walter from the periods of libration are not valid. AUTHOR.

*See also* Abstract 4880.

## NEBULÆ.

**4836. Physical Processes in Gaseous Nebulæ. Part V. Electron Temperatures. J. G. Baker, D. H. Menzel and L. H. Aller.** *Astrophys. J.* 88. *pp.* 422–428, *Nov.*, 1938.—The relation between the electron temperature of a gaseous nebula and the temperature of the exciting star is derived and applied to an optically thin nebula. The $b_n$'s have been recomputed both with the radiation field included and as a function of the temperature of the exciting star. The Balmer decrement proves to be steeper when the influence of Lyman line absorption is included. [For Part IV see Abstract 4385 (1938).] AUTHORS.

## PLANETS.

**4837. Two New Satellites of Jupiter (J X and J XI). J. Jackson.** *Roy. Astron. Soc., Occasional Notes, No.* 2. *pp.* 23–25, *Oct.*, 1938.—For J XI no orbit is found; for J X, it is uncertain whether the orbit is direct or retrograde; if direct, $a = 5{\cdot}9 \times 10^6$ miles, $e = 0{\cdot}636$; if retrograde $a = 18{\cdot}3 \times 10^6$ miles and $e = 0{\cdot}621$. If J X is direct, it will interlock with J VI and J VII; if retrograde, it will class with J VIII and J IX. On both assumptions the eccentricity is larger than anything, except comets, in the solar system. Both satellites are probably less than 10 miles in dia. and the large range in size for Jovian satellites should prove of cosmological importance; it may be that J X is not a permanent satellite, owing to the great solar attraction upon it; it may be sometimes a satellite and somes a minor planet. A. S. D. M.

## STARS.

**4838. Photographic Red-Intensities of Praesepe. O. Heckmann.** *Göttingen Nachrichten, Fachgruppe* II. 2. 18. *pp.* 217–236, 1937.—A method is described by which the magnitudes of the stars of the Praesepe cluster were determined in red light. The Schott-filter RG1 together with Agfa-plates (*Spektral Rot Hart*) gave the centre of gravity of the spectral region at $6450 \pm 15$ Å. The corrections are given which must be applied to the measurements, and the accuracy of the method is discussed in detail. The results of the observations are compared with those of other observers. [See following Abstract.] L. K.

**4839. Colour-Luminosity Diagram of Praesepe. H. Haffner and O. Heckmann.** *Göttingen Nachrichten, Fachgruppe II.* 2. 19. *pp.* 237–255, 1937.—The colour indices and stellar magnitudes $^m{}_{4270}$ and $^m{}_{6450}$ which have been determined photometrically, are tabulated for the stars of the Praesepe cluster together with those of some brighter red stars and weaker white stars which do not belong to the cluster. The relation between the colour indices and the luminosities is shown in a diagram. Along the line round which the greater part of the stars is distributed, the

relation between colour and luminosity is unambiguous. Among the stars of $m > 8{\cdot}5$ are approximately 20% double stars which lie outside this line. Their number does not depend on the absolute magnitude and corresponds to the usual ratio of spectroscopic double stars of the type A, F and G occurring among giant stars. [See preceding Abstract.] L. K.

**4840. Scatter of Absolute Magnitudes in the Main Sequence. J. Hopmann.** *Naturwiss.* 26. *p.* 631, *Sept.* 23, 1938.—By using the most recent and accurate catalogues of apparent magnitudes, spectral types, and parallaxes, the scatter in the absolute magnitude–spectral type diagram is found to be $\pm 0{\cdot}54$ mag. between A0 and K6 stars. To the experimental uncertainty the photometric results contribute least and the parallax measures, even for selected stars at small distances, most. Allowing for these sources of error, the cosmical scatter in the neighbourhood of the sun reaches $\pm 0{\cdot}40$ mag., much more than that observed in the Praesepe cluster. The figure for the Pleiades is $\pm 0{\cdot}25$, for the Hyades $\pm 0{\cdot}35$, both also much greater than for the Praesepe cluster. In the Hyades, as in the neighbourhood of the sun, a third of the stars are visual or spectroscopic binaries. The preponderance of F, G, and K stars in these regions suggests that duplicity in stellar systems is still more likely to be a normal development than had hitherto been supposed. A. Hu.

**4841. Generalisation of Lindblad's Theory of Star-Streaming. S. Chandrasekhar.** *Roy. Astron. Soc., M.N.* 98. *pp.* 710–726, *Oct.*, 1938. *Supplement.*—The treatment of the observed stellar motions shows that the axis of preferential motion—the largest axis of the velocity ellipsoid—lies in the galactic plane and is directed towards the galactic centre (this is the radial axis). On the other hand, the theoretical study of stellar systems, with cylindrical symmetry and assumed to be in a steady state, has hitherto led to the result that the radial axis and the axis perpendciular to the galactic plane (the polar axis) are equal. By a generalisation of Lindblad's theory of star-streaming [see Abstract 3089 (1936)] the paper removes this inconsistency and demonstrates that, for a steady state of the system, the radial and polar axes are unequal. The paper also predicts for a group of stars at a considerable height above the galactic plane a definite tilt of the principal axes of the velocity ellipsoid in the meridian plane; in other words, the greatest axis is no longer parallel to the galactic plane. Author.

**4842. Radial Velocity-Curve of the RR Lyræ Variable W Canum Venaticorum. A. H. Joy.** *Mt. Wilson Observat. Contrib. No.* 599. *Astrophys. J.* 88. *pp.* 408–410, *Nov.*, 1938.—24 spectrograms of the short-period variable W Canum Venaticorum were obtained, mostly by the use of a 6-in. camera and a one-prism spectrograph giving a dispersion of 120 Å/mm. The velocity-curve closely resembles the light-curve by Detre, but a lag of 6% of the period is noted. The normal velocity is + 26·0 km./sec. with a total range of 70 km./sec. The spectroscopic absolute magnitude of — 0·4 and a distance of 1400 parsecs were determined. Author.

**4843. Tables Facilitating Calculation of Line Absorption Coefficients. F. Hjerting.** *Astrophys. J.* 88. *pp.* 508–515, *Nov.*, 1938.—A table of the integral $\frac{a}{\pi}\int_{-\infty}^{+\infty} \frac{e^{-v^2}dy}{a^2+(v-y)^2}$ is calculated by numerical quadratures for values of $a$ up to 0·2, and, with somewhat less accuracy, for values of $a$ up to 0·5. Author.

**4844. Integration of Equation of Radiative Transfer. P. Swings and L. Dor.** *Astrophys. J.* 88. *pp.* 516–521, *Nov.*, 1938.—The equation of radiative transfer has been integrated by a generalisation of Spitzer's method, which makes use of Bessel functions. [See Abstract 524 (1938).] AUTHORS.

**4845. Nuclear Transformations in the Interior of Stars. Part II. C. F. v. Weizsäcker.** *Phys. Zeits.* 39. *pp.* 633–646, *Sept.* 15, 1938.—The difficulties of the author's hypothesis [for Part I see Abstract 1989 (1937)] are outlined. The synthesis of the heavier elements from neutrons, whose production is bound up with that of He, leads to a lower limit to stellar He abundance which is incompatible with observational evidence. The energy production in stars is likely to depend only on reactions involving the lighter nuclei, the determining ones as yet being uncertain. The cyclic processes of Part I are now considered unlikely from the point of view of nuclear physics, and a cycle in which C catalyses the production of He is suggested. Such a cycle gives an abundance distribution of the lighter elements in accordance with observation. Different types of reaction have to be assumed for giants and dwarfs respectively : for the former a steady cyclic process is suggested, for the latter a nuclear decomposition. The necessary physical conditions for the formation of the elements are investigated, particular attention being paid to the temperatures (*c.* $2\times10^{11}$) needed for the production of all nuclei in comparable numbers. Where the mass involved is of an order greater than stellar masses, such temperatures can probably be produced temporarily, but are followed by an explosion. The bearing of this idea on the redshift of the spiral nebulæ is discussed. A. Hu.

**4846. Microphotoemeter Measurements of Variable Star SU Draconis in 1935-1936. W. Opalski.** *Acad. Polonaise Sci. et Lettres, Bull.* 3–5*A*. *pp.* 204–217, *March–May*, 1938. *In German.*

**4847. Photographic Light-Curves of the Two Supernovæ in IC 4182 and NGC 1003. W. Baade and F. Zwicky.** *Mt. Wilson Observat. Contrib. No.* 601. *Astrophys. J.* 88. *pp.* 411–421, *Nov.*, 1938.—Photographic light-curves of the two supernovæ in IC 4182 and NGC 1003 have been derived from plates obtained at the Palomar and the Mount Wilson observatories. Since the distance moduli of the two nebulæ are known, the absolute photographic magnitudes of the supernovæ can be computed. At maximum their values were $M = -16{\cdot}6$ and $-14{\cdot}0$, respectively. An integration of the light-curve of the supernova in IC 4182 shows that during the outburst this star emitted radiation in the photographic region equivalent to $4\cdot10^7$ years of solar radiation within the same spectral range. AUTHORS.

**4848. Spectral Classification in Kapteyn's Selected Areas. H. Brück.** *Observatory*, 61. *pp.* 262–267, *Oct.*, 1938.—The *Spektral Durchmusterung* of the southern Kapteyn area (70,000 stars down to the 12th mag.) and the Bergedorfer *Spektral Durchmusterung* for the northern area, are now complete. The author reviews this work and its history, beginning with the Draper catalogue, containing 225,700 stars down to mag. 8·5. For these, the types A and K are most frequent, but going from brighter to fainter, B stars decrease in number, G stars increase ; the frequency of other types being constant. Early stars concentrate towards the Galaxy, but F and G stars do not. Both the new catalogues give indications for brighter stars if they are giants or dwarfs. Both show that even in the Milky Way there are no B stars of the 12th mag.

The *Spektral Durchmusterung* derives density gradients for different galactic latitudes but here are seen the limitations of the Kapteyn areas, since these are distributed symmetrically to the equator, and include only a small part of the Milky Way. A. S. D. M.

*See also* Abstracts 4833, 4835.

### SUN.

**4849. Corpuscular Eclipse of 1940 Oct. 1.** *Roy. Astron. Soc., M.N.* 98. *pp.* 727–733, *Oct.*, 1938. *Supplement.*—A brief description is given of the adaptation of the occultation machine in the *Nautical Almanac* Office to the prediction of the corpuscular eclipse ; times of beginning and end at a network of points covering South Africa are tabulated for the two heights of 100 km. and 300 km. and for two assumptions as to the effective radiating diameter of the sun. A speed of propagation of 1000 miles a second is assumed for the particles, but an indication is given of the variation of the times for a change in the assumed speed. [See also Abstract 4011 (1938).]

**4850. Hydrogen Lines Near the Balmer Limit. A. Pannekoek.** *Roy. Astron. Soc., M.N.* 98. *pp.* 694–709, *Oct.*, 1938. *Supplement.*—The theoretical work of Robertson and Dewey [see Abstract 2721 (1928)], and of Lanczos [see Abstract 2313 (1931)] on the dissolution of the highest levels of an atom by electric fields is applied to the disappearance of the higher members of the Balmer series. Their intensity curves in the emission spectrum of a partly ionised gas are computed. The merging of the highest Balmer lines into continuous radiation allows the derivation of the electron density in an atmosphere by means of the number of visible lines. This is applied to the solar chromosphere. AUTHOR.

## GEOPHYSICS.

### GEOPHYSICS, APPLIED.

***4851. Short-Period Fractional Error of a Coincidence Theodolite. H. Kasper.** *Zeits. f. Instrumentenk.* 58. *pp.* 443–448, *Nov.*, 1938.—A series of tests was carried out on some modern theodolites with coincidence readings to determine whether the newly finished circular divisions on glass also had the short-period fractional errors such as can be observed on metal circles of the time of Forster. The programme of tests and the derivation of the errors are described. The results show that for a Zeiss universal theodolite, II, the errors are not present. R. S. R.

*See also* Abstract 4874.

### HYDROSPHERE, PHYSICS OF THE.

**4852. Radium Content of Marine Sediments. Robley D. Evans and A. F. Kip.** *Am. J. Sci.* 36. *pp.* 321–336, *Nov.*, 1938.—The mean Ra concentration in 11 terrigenous-mud ocean-bottom deposits from the vicinity of the East Indies, the Philippines and Japan is $2 \cdot 5 \times 10^{-12}$ gm. Ra per gm., or about 5 to 10 times the usual values for sedimentary rocks. The terrestrial occurrences of so-called fossil deep-sea clays on Borneo, Rotti and Timor have a much lower Ra concentration than contemporary

deep-sea red-clays or even terrigenous muds. These analyses suggest either that Ra, not U, is primarily precipitated in the ocean-bottom sediments, or that the East Indian fossil deep-sea clays are shallow-water deposits. The geological evidence supporting the abyssal origin of these deposits seems strong enough to warrant the conclusion that the high Ra content of fresh deep-sea red clays is mainly due to the precipitation of Ra itself, without regard to the oceanographic behaviour of U. AUTHORS.

## LAND, PHYSICS OF THE.

**4853. Magnetic Anomalies and Subterranean Mass Distribution. T. Nagata.** *Tokyo Univ. Earthquake Research Inst. Bull.*, 16. *pp.* 550–576, *Sept.*, 1938. *In English.*—An extension of a previous paper [see Abstract 4022 (1938)]. Relations are established between the magnetic anomalies and the corresponding subterranean magnetic plane and magnetic dykes, and examples of each are given. Finally the magnetic anomalies in dip and declination are treated. Correction formulae must be used for the observed values where the earth's surface is too undulating to be treated as a horizontal plane. R. S. R.

**4854. Effect of Cooling on a Plastic Earth under Gravitational Forces. Part II. K. Sezawa and K. Kanai.** *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 527–536, *Sept.*, 1938. *In English.*—Continuing previous work [see Abstract 4028 (1938)] in which the cooling of a uniform layer was assumed to take place uniformly, the case is investigated in which cooling in the earth's crust is of any distribution with depth. The effect of the cooling of any part of the earth on its plastic deformation is slight compared with the effect of gravitational forces on the same deformation. An important condition is that the rigidity of the crust shall not be zero, for the state of a solid earth differs from that of a liquid earth of equal radius. The plastic stress due to temperature change never participates greatly in the total stress. W. A. R.

## METEOROLOGY.

**4855. Vertical Distribution of Atmospheric Ozone. F. W. P. Götz.** *Gerlands Beitr. z. Geophys., Supplementband* 3. *pp.* 253–325, 1938. —Review of the subject, containing a Bibliography of 318 references.

**4856. Frontal Movements Contrary to Indicated Gradient Flow. A. K. Showalter.** *Monthly Weather Rev.* 66. *pp.* 165–174, *June*, 1938.—A problem which often presents itself is the movement of a front against the gradient flow indicated by sea-level isobars. The displacement of a frontal surface is produced by component winds normal to the front. There is also the effect of the isallobaric component. This may be in the opposite direction to the gradient flow especially near a warm front. It is, therefore, possible that a front may move against the indicated gradient. This can be applied to the solution of the problem of a cold front extending to the north or north-east of a low pressure. A detailed treatment is given of the flood-producing storm in Oklahoma in April, 1934, where such a front was present and moved against the gradient flow. The author considers that the displacement in this and similar cases took place by means of the isallobaric component. Further, as the result of the opposing forces is to sharpen the temperature contrast along the trough, there is instability and a continuous breaking down by minor waves. The minor waves may become intense and produce heavy rains. Many synotpic charts illustrate the paper. A. E. M. G.

**4857. Tornado of July 7, 1938, in Chiltern Hills. E. L. Hawke.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 616–618, *Oct.*, 1938.—The phenomenon which is described in detail occurred during one of the many thunderstorms which broke over England on that date. It appears to have been coincident with the passage of a well marked cold front. An account of the damage done is given and a diagram shows the track of the storm. A. E. M. G.

**4858. Artificial Snow. U. Nakaya.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 619–624, *Oct.*, 1938.—The author, having first made clear what he means by the term " snow crystal ", proceeds to describe the methods used for producing these crystals. The apparatus used is shown diagrammatically. It was placed in a chamber which could be cooled to $-50°$ C. The crystals were formed on a fine hair or fibre and records of the temperature of the evaporating surface, the fibre and the chamber were made. Twelve types are illustrated, which are classified in three groups. Investigation shows that the form of the crystals in the early stage exerts a strong influence on the mode of growth of the snow crystal proper. The temperature conditions under which different types are formed are stated, from which conditions in nature may be inferred. Investigations are also being pursued to determine the conditions under which ice of different crystal symmetry is formed. From experiments on sublimation of ice the author considers that delicate ice crystals are formed in an unstable state by the *mixing* of saturated air at a low temperature with warm vapour. To test this, further experiments are proceeding. A. E. M. G.

**4859. Industrial Smoke Drift and Weather. H. H. Lamb.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 639–643, *Oct.*, 1938.—Particulars are given of a series of observations made in East Scotland when passing through an area of smoke haze drifting from Glasgow. The effect of the hills in deflecting the smoke drift was pronounced. At one point the smoke was accompanied by slight rain and it is concluded that this forms an example of the instability of a cloud of drops, called by Shaw the " effect of capillarity," whereby the bigger drops grow by slowly stealing water from the smaller ones. R. S. R.

**4860. Atmospheric Condensation Nuclei. H. Landsberg.** *Gerlands Beitr. z. Geophys., Supplementband* 3. *pp.* 155–252, 1938. *In English.* —Review of the subject, containing a Bibliography of 227 references.

**4861. Apparent Persistence of One Type of Weather. W. G. Cochran.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 631–634, *Oct.*, 1938.—If a meteorological event is of two types only, for instance wet or dry months, and these occur independently with equal probability, Gold showed that the probable number of runs of length, $r$, out of $m$ events is $(m+3-r)/2^{r+1}$. Two further results are needed to complete the application of the formula. (1) The formula is extended to cases in which the chances of two events are unequal and it is shown that the comparison of the observed set of runs with Gold's formula suggests the persistence of long runs whether there is any real persistence or not. (2) An objective test of significance is required giving the exact probability that a given set of runs, or a more divergent one, should have occurred without any real tendency to recurrence. This is illustrated by two examples. R. S. R.

**4862. Coronæ and Anticoronæ in Fogs. J. Bricard.** *Comptes Rendus*, 207. *pp.* 538–540, *Sept.* 26, 1938.—When the mean radius of particles is less than $8\mu$, then the presence of diffraction rings in coronæ can be detected. To obtain coronæ the author used a Hg arc with suitable

filters as a source of monochromatic light, allowing the light to pass through several metres of fog. From the diameters of the coronæ so obtained, the radii of the particles were calculated and the values found to agree satisfactorily with those obtained by two other methods. The method of obtaining coronæ and anticoronæ is next described. A correspondence is shown to exist between certain rings in the two sets, and from the diameters of the anticoronæ, the radii of the particles were found. An examination with a Savart plate revealed the presence of a certain amount of polarised light in the coronæ. **Errata,** *ibid. p.* 604, *Oct.* 3, *and p.* 878, *Nov.* 7, 1938. A. E. M. G.

**4863. Aurora of January 25-26, 1938. C. Störmer.** *Naturwiss.* 26. *pp.* 633–638, *Sept.* 30, 1938.—1685 photographic observations of auroræ have been made on 28 nights from Jan. to June, 1938, at Oslo and at 7 other stations within a radius of 130 km., arranged in 2 networks of 4 stations each. In many cases simultaneous observations at two or more of these stations enable the height and geographical position of the auroræ to be calculated. Results are given in detail for the intense display of Jan. 25–26, photographs of the various curtains and streamers being reproduced and discussed. The green rays appear at heights of the order of 100 km., the red at about 600 km. Streamers some 200 km. long extended from N. to S. over E. Denmark, whilst some extended from E. to W. over the North Sea practically from the Scottish coast to that of Norway. Spectroscopic observations establish that the difference of colour is due to a difference of relative intensity in the spectral lines and bands : all auroræ show the 6300 and 5577 Å lines and the 6550 and 4278 Å bands, but in the red glow the red O line is by far the strongest feature. A. Hu.

**4864. Auroral Spectrum. L. Vegard.** *Naturwiss.* 26. *pp.* 639–644, *Sept.* 30, 1938.—The author emphasises the importance of the study of auroral phenomena in increasing our knowledge of the composition and physical condition of the upper atmosphere. The electronic transitions giving the $N_2$ and $N_2^+$ bands and the O I lines in the auroral spectrum are discussed, and the production is described of certain of these features in the luminescence of solid nitrogen and in afterglow spectra. The author reviews the results obtained from a study of the intensity distribution of the lines in a band, of the bands in a system, and of the systems in the whole spectrum. Possible mechanisms are discussed for the reactions between nitrogen and oxygen molecules and atoms in the upper atmosphere. The concentration of O atoms appears to vary with solar activity. The nature of the solar agencies producing the auroræ is discussed in conjunction with the recent results on the constitution of the ionosphere obtained by radio echo sounding. A. Hu.

**4865. Polar Aurora and Night-Sky Light. H. H. Plaskett.** *Roy. Astron. Soc., Occasional Notes, No.* 2. *pp.* 13–22, *Oct.*, 1938.—General features of the aurora relating to its height, the two types, the lines and bands in its spectrum, and the atomic transitions causing them are described. The method of measurement, layers of origin, spectral investigations and their variation with time for the night-sky light are next discussed. For the origin of these phenomena Chapman's theory for the night-sky light, those of Birkeland, Störmer and Lindemann for the aurora, and of Milne for magnetic storms are outlined. It is concluded that further investigation is needed to decide the connection between these three phenomena. R. S. R.

**4866. Brightness of Sky in Zenith. P. Gruner and T. Klee.** *Helv. Phys. Acta*, 11. 6. *pp.* 513–530, 1938. *In German.*—An attempt is made to calculate the brightness of a clear sky for red, green and blue light. The theory is simplified by neglecting multiple scattering in the atmosphere, the effect of which is assumed to be small. Deviations of observed values from those now calculated are attributed to turbidity in the sky, and can be used to investigate such turbidity. C. B. A.

**4867. Recent Twilight Investigations. P. Gruner.** *Gerlands Beitr. z. Geophys., Supplementband* 3. *pp.* 113–154, 1938.—Review and Bibliography of the subject.

***4868. Psychrometric Charts. J. G. Albright.** *Monthly Weather Rev.* 66. *pp.* 178–181, *June*, 1938.—Two charts have been constructed, one for use with Fahrenheit temperatures, the other for Centigrade, from values given in the Psychrometric Tables and Relative Humidity, Centigrade Temperature publications of the U.S. Weather Bureau. The method of constructing charts is given and an example of their use set out. Great accuracy in the results attainable is not claimed. The charts are reproduced. A. E. M. G.

***4869. Exploration of Atmosphere by Radio-Sonde. R. Bourgeois.** *Comptes Rendus*, 207. *pp.* 611–613, *Oct.* 10, 1938.—At Trappes a radio-sonde ascent has been made each day since Jan. 1, 1938, and in six months 181 ascents reached the stratosphere. The cruise of the ship *Carimaré* near the Azores has provided a full forecasting station day and night in this area and ship and land observations have been collected. Radio-sonde ascents have been made each day for three months from the ship. Details are given of the height and temperature at the tropopause for the land and sea stations. R. S. R.

***4870. Pilot Balloon Theodolite. R. Cranna.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 613–615, *Oct.*, 1938.—The types of pilot balloon theodolite used are all based on that designed by de Quervain in 1905. The features of the two main types hitherto used at the Meteorological Office outstations are described. The present instrument has been built to incorporate the desirable features of the two types and to improve upon any shortcomings common to both. The remodelling of the mechanical system which is fully described has simplified the illumination of the theodolite necessary for night ascents. A. E. M. G.

***4871. Anemoclinometer I.M.F.L. G. T. Walker.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 625–629, *Oct.*, 1938.—In a description of the instrument it was stated that although the anemoclinometer was fixed in direction the registration was not affected by more than 3% provided that the angle ($j$) between the wind and the direction in which the instrument was pointing was not more than 45°. It was also shown how small angles such as 4° in the inclination ($i$) of the wind to the horizontal or the azimuth ($j$) could be derived from the traces. Formulæ were developed for these cases by Martinot-Lagarde and diagrams are given showing the large range over which they apply. It is confirmed that for such cases as normally occur in ordinary weather with $i \not> 5°$ and $j < 45°$ the formulæ hold and $i$ and $j$ can be readily determined. R. S. R.

**4872. Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year Ended March 31st, 1938.** *Air Ministry Publications, M.O.* 428. [61 *pp.*], 1938.

**4873. Aerological Observations by Means of Kites, Aeroplanes and Sounding Balloons in U.S.A. C. M. Lennahan.** *Monthly Weather Rev. Suppt. No.* 38. [65 *pp.*], *Sept.*, 1938.

*See also* Abstracts 4748, 4904, 4935, 5003, 5075 and 3484B. Progress in Weather Forecasting. W. R. Gregg.

## SEISMOLOGY.

**4874. Explanation of Different Wave Groups in Seismograms of Explosions. R. Köhler.** *Göttingen Nachrichten, Fachgruppe II.* 2. 13. *pp.* 145–165, 1936.—Seismograms caused by explosions 50–180m. distant from the point of observation were investigated and harmonic analysis was used to determine the periods of the pressure and shearing waves produced. It is shown that a better explanation can be obtained of processes occurring near the surface if not only the time of arrival but also individual phase movements are examined. This is especially true of later waves which are independent of the layers penetrated. It is shown that the true properties of the ground can thus be determined. R. S. R.

**4875. Damping of Periodic Visco-Elastic Waves with Increase in Focal Distance. K. Sezawa and K. Kanai.** *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 491–502, *Sept.*, 1938. *In English.*—Rayleigh waves, Love waves, and plane and radial bodily waves (dilatational and distortional) are discussed by treating the behaviour in transmission of a periodic visco-elastic wave whose amplitude at its source is constant. W. A. R.

**4876. Formation of Boundary Waves at the Surface of a Discontinuity within the Earth's Crust. Part I. K. Sezawa and K. Kanai.** *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 504–525, *Sept.*, 1938. *In English.*—The paper is a mathematical investigation of the way in which waves generated from a point source in the solid excite boundary waves at any discontinuous surface in the same solid. Distortional and dilatational primary waves are considered, and the problem is treated as involving two dimensions only. W. A. R.

**4877. Three Dimensional Vibrations of a Framed Structure. K. Kanai.** *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 538–549, *Sept.*, 1938. *In English.*—In continuation of an earlier investigation a general solution is obtained for the three-dimensional vibration of a structure which in itself is apparently in a two-dimensional condition. This is found to depend upon certain conditions of the structure as well as the direction of movement of the seismic vibrations. The detailed nature of the vibrations for different cases has been considered. The mathematical results were confirmed by model experiments from which it was shown that in spite of the extremely complex forms of the mathematical solutions there was little error even in the numerical constants of the solutions. R. S. R.

**4878. Origins of Earthquakes. W. Inouye.** *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 597–630, *Sept.*, 1938. *In English.*—The data regarding several deep-focus earthquakes are compared with the results of theoretical treatment of elastic waves assuming that both normal and tangential stresses change with a certain rapidity over a spherical cavity at the seismic focus. It is concluded that in such cases the stresses attain their final values in about the time taken by the waves to travel a distance equal to the radius of the seismic focus, their wavelengths being comparable thereto, while the range of stress changes at the

focus is of the order of $10^6$ dynes/cm$^2$. [See Abstract 1100 (1938).] C. A. S.

*See also* Abstracts 4854, 5077.

### TERRESTRIAL ELECTRICITY AND MAGNETISM.

**4879. Diurnal Variation of the Magnetic Pole. K. F. Wasserfall.** *Terr. Mag.* 43. *pp.* 219–225, *Sept.*, 1938.—Mean values of the magnetic elements obtained by Amundsen at Gjoahavn for the year 1904 were used to plot the diurnal variation of the magnetic pole. This shows as an oval 22km. from E. to W. and 14 km. from N. to S. The results were compared with those at Dombas and Godhavn. The agreement between observation and theory supports the Chapman-Bartels theory that an electromagnetic current system exists in the ionised part of the atmosphere and that it is responsible for the main features of the quiet diurnal variation of the magnetic elements even for stations quite near the magnetic pole. It is also concluded that the diurnal variation of the magnetic pole is caused by this current system. R. S. R.

**4880. Radiation of the Earth's Angular Momentum. T. Schlomka.** *Ann. d. Physik*, 33. 3. *pp.* 259–264, *Oct.*, 1938.—The earth being a rotating magnet, the electromagnetic radiation from it must cause a reduction of the angular momentum. A calculation is made, using the known strength of the earth's magnetic field, to determine the increase in the length of the day due to this cause. It is found to be insignificant during geological time. G. C. McV.

*See also* Abstracts 4853, 4865, 5003.

## RADIOACTIVITY.

**4881. Naturally Radioactive Elements. W. Minder.** *Helv. Phys. Acta*, 11. 6. *pp.* 497–506, 1938. *In German.*—In a hypothetical discussion of the mechanism of radioactive decay, the dependence of the neutron-proton ratio (A-Z)/Z on the atomic number is obtained for the various elements. A similarity is found to exist between the three decay series, *viz.*, U, Th and Pd. The total variation of the ratio (A-Z)/Z for the radio-active elements is found to lie in the range 1·50 to 1·61. Those elements with a high ratio are mostly $\beta$-radiators while those with low values are $\alpha$-radiators. A suggestion is made with regard to the gaps at 85 and 87 in the atomic table. G. O. B.

**4882. Existence of Thorium-Polonium. J. Schintlmeister.** *Akad. Wiss. Wien, Ber.* 147. 2*a*. 3–4. *pp.* 161–179, 1938.—Using a valve amplifier and a differential ionisation chamber, an attempt was made to test the existence of Th-Po. No $\alpha$-particle emission was observed and the half-life of one of the three bodies ThD, ThE or ThF would have to be greater than $10^{13}$ *y*. It therefore seems very improbable that $Pb^{204}$, found by the mass spectrograph, can arise entirely from the theoretically possible disintegration of ThD. F. C. C.

**4883. Production of Long-Lived Radioactive Co Isotope from Ni Bombarded by Fast Neutrons. O. Viktorin.** *Cambridge Phil. Soc., Proc.* 34. *pp.* 612–613, *Oct.*, 1938.—It is shown that a long-lived radioactive

Co isotope, which had been previously obtained by Livingood and Seaborg [*Phys. Rev.* 53. *p.* 847, *May* 15, 1938] by bombardment of Co with slow neutrons, can be produced by irradiation of Ni with fast neutrons.

AUTHOR.

**4884. Disintegration of Carbon by Fast Neutrons. H. Aoki.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 755–756, *Sept.*, 1938.—Wilson chamber photographs of the result of bombarding C (present as $CH_4$ or vapour of EtOH) with neutrons from Li + D showed nine " tridents " in 910 pairs of photographs, while none were observed when the source of neutrons was D + D. Energy calculations favour the explanation that this is due to the reaction $^{12}C + {}^1n \rightarrow {}^3He + {}^1n$, rather than to $^{12}C + {}^1n \rightarrow 2{}^4He + {}^5He$. [See Abstract 3458 (1934).] C. A. S.

**4885. Disintegration of Fluorine by α-Particle Bombardment. N. K. Saha.** *Zeits. f. Physik*, 110. 7–8. *pp.* 473–494, 1938.—An account is given of a series of measurements made to determine the relation between the various disintegration processes produced in F when it is bombarded with α-particles from Po. The excitation curves for the production of protons, neutrons and γ-rays are shown and the resonance levels are determined for each process. The probability of the intermediate nucleus disintegrating with emission of a proton or a neutron is investigated. The total yield of neutrons appears to be about the same as that of protons and from this fact and other evidence it is deduced that the γ-ray emission is associated with the neutron emission as well as with the proton emission. The evidence indicates that the probability of γ-ray emission as a consequence of an inelastic collision between the incident α-particle and the F nucleus must be very much smaller than the probability of the other processes. The least energy which will cause neutron emission is found to be slightly less than that for proton emission. It is calculated that an upper limit for the mass of $Na^{22}$ is $<22{\cdot}0022$. J. E. R. C.

**4886. Artificial Disintegration of Ne. K. Gailer.** *Zeits. f. Physik*, 110. 9–10. *pp.* 605–610, 1938.—By bombarding Ne with fast neutrons which possess a continuous energy distribution, α-particles are liberated whose energies are found to lie in discrete groups. The measured total energies, of α-particle and recoil nucleus, are 1·7, 2·4, 3·8, 4·8 and 5·3 eMV. These groups can be arranged as excitation states of the intermediate nucleus $Ne^{21}$ which becomes $Ne^{23}$. Such an arrangement is not entirely satisfactory so long as it is not clear which excitation states of the final nucleus can result in the process. G. O. B.

**4887. Angular Distribution in Nuclear Transitions. C. Reinsberg.** *Zeit. f. Physik*, 110. 11–12. *p.* 765, 1938.—A correction. [See Abstract 1568 (1938).]

**4888. Nuclear Transformations Produced in Zinc by α-Particle Bombardment. W. B. Mann.** *Phys. Rev.* 54. *pp.* 649–652, *Nov.* 1, 1938.—Zn has been bombarded with 17 eMV α-particles and the consequent radioactivity observed. The disintegration products are mainly positrons; the half-lives of the observed activities are $19{\cdot}8 \pm 0{\cdot}4$ min., $37 \pm 1{\cdot}5$ hr., $79 \pm 2$ hr. and about 195 days. A chemical separation indicates that the first and third of these activities are due to Ga and the remaining two to Ge. The two Ga activities may be respectively assigned to $Ga^{70}$ and $Ga^{67}$. No very definite assignment has been possible, however, with respect to the activities associated with Ge. AUTHOR.

**4889. Nuclear Transmutations of Li Isotopes. L. H. Rumbaugh, R. B. Roberts and L. R. Hafstad.** *Phys. Rev.* 54. *pp.* 657–680,

*Nov.* 1, 1938.—Yield curves have been obtained for eight of the more important reactions of $Li^6$ and $Li^7$ produced by proton and deuteron bombardment in the energy range from 200 to 1000 ekV. Each curve was obtained with an accuracy of about 5%, and a set of intercomparisons served to determine the relative yields between the different reactions within 20%. A special set of observations on a single reaction then gave the absolute yield for all the reactions within a factor of about three. An investigation was made of the reactions involved in the formation and decay of $Li^8$, the mass of which was found to be $8{\cdot}02499 \pm 0{\cdot}00020$. The range-distribution of the delayed $\alpha$-particles from $Li^8$ was measured and the interpretation of this distribution is discussed. Observations on the reaction $Li^6+n \rightarrow He^4+H^3$ gave a value of 4·97 eMV for the reaction energy as compared to a value of 4·56 eMV derived from the masses involved. No evidence could be obtained for the production of $Li^8$ by the process $Li^7+n \rightarrow Li^8$. Measurements of the energies of the neutrons produced by deuteron bombardment of $Li^6$ indicated that $Be^7$ is formed by the reaction $Li^6+D^2 \rightarrow Be^7+n$. Further experiments showed that $Be^7$ is radioactive and is converted to $Li^7$ by K-electron capture. It was found that this process is followed by $\gamma$-ray emission in roughly 10% of the transitions. [See following Abstract.] AUTHORS.

**4890. K-Electron Capture in $Be^7$. G. Breit and J. K. Knipp.** *Phys. Rev.* 54. *pp.* 652–656, *Nov.* 1, 1938.—There is no observed positron emission in $Be^7$. This sets an upper limit of $2{\cdot}0\dot{9}\ mc^2$ for the mass difference $Be^7$–$Li^7$ from Fermi's theory and $2{\cdot}3\ mc^2$ from the Konopinski-Uhlenbeck theory. This upper limit is compared with other estimates of the same mass difference. The $\gamma$-ray emission accompanying the disintegration probably takes place after the $K$ capture from an excited state of $Li^7$ having a spin $\frac{1}{2}$. The $K$-capture transition to $i = \frac{1}{2}$ from $i = \frac{3}{2}$ is according to experiment only $\frac{1}{10}$ as weak as that to $i = \frac{3}{2}$. This speaks for the Gamow-Teller type of selection rules. The mean lives of $He^6$, $Be^7$, $C^{11}$ are compared. It is found that the observed mean lines are relatively shorter for the lighter nuclei than Fermi's theory predicts. This is in apparent contradiction with the preference shown for the Fermi theory by the $\alpha$-particle distribution from $Li^8$. From a theory without derivatives, the facts seem to point either to an appreciable increase in the many-body aspect of nuclei from $He^6$ to $C^{11}$ or else to a decrease in the intrinsic $\beta$-emitting powers of nuclear particles in heavier nuclei. On the Konopinski-Uhlenbeck theory some of the disagreement can be removed but the $\beta$-particle distribution from $Li^8$ (Gamow and Teller) speaks strongly against using this theory for mean lives. [See preceding Abstract.] AUTHORS.

**4891. Decomposition and Synthesis of HI by $\alpha$-Particles. K. G. Brattain.** *J. Phys. Chem.* 42. *p.* 974, *Oct.*, 1938.—A correction. [See Abstract 3200 (1938).]

**4892. $\alpha$-Rays from Mesothorium 2. E. Rona and J. Schintlmeister.** *Akad. Wiss. Wien, Ber.* 147. 2*a*. 1–2. *pp.* 49–62, 1938.—Using two different experimental arrangements, absorption curves are obtained which show that, in agreement with the results of Hahn and Rotenbach and in contradiction with those of Guében, mesothorium 2 emits no $\alpha$-particles within an accuracy of an $\alpha$-$\beta$ branching ratio of $2 \times 10^{-4}$. F. C. C.

**4893. Natural H-Rays. J. Riedl.** *Akad. Wiss. Wien. Ber.* 147. 2*a*. 3–4. *pp.* 181–195, 1938.—By means of the photographic method, an investigation has been made of the energy spectrum of the protons liberated

in a forward direction on bombardment of paraffin with Po $\alpha$-rays. Both thick and thin paraffin layers have been used. Four range groups have been found, having the values 7·6, 10·1, 11·9 and 13·2 cm. in air. The first and fourth of these can be compared with the first two groups found by Frank. [See Abstract 4490 (1934).] G. O. B.

**4894. Absorption Method of Investigating Primary $\beta$-Particles from Radioactive Substances. N. Feather.** *Cambridge Phil. Soc., Proc.* 34. *pp.* 599–611, *Oct.*, 1938.—A detailed account is given of an absorption method, using the $\beta$-radiation of Ra E as a standard of comparison, by which the maximum energy and some indication of the form of the energy spectrum of the $\beta$-particles from any other radioelement may be obtained. The method is applicable alike to weak sources and to sources of finite thickness and is designed to yield the largest amount of information under such limitations. Experimental results with sources of $UX_2$, $Na^{24}$, $Ag^{106}$ and $P^{32}$ are treated by the method described. A modified empirical range-energy relation is given. [See also Abstract 3637 (1938).] Author.

**4895. Application of Clay's New Value of the Jaffé-Zanstra Coefficient for Air to High Pressure Ion Current Measurements. J. W. Broxon and G. T. Merideth.** *Phys. Rev.* 54. *pp.* 605–608, *Oct.* 15, 1938.—Clay [see Abstract 4338 (1935)] has found the coefficient $1{\cdot}24(10)^{-4}$ employed by Zanstra in his treatment of high pressure ionisation data for air by Jaffé's columnar theory, should actually be applied to $N_2$, and the coefficient $10^{-5}$ substituted in the case of air. The authors have used the new coefficient in a repetition of the analysis of their experimental data. The straight lines predicted by the theory are obtained in the collecting field range, 1769-4520V/cm, in most cases, and the curvatures of the Jaffé-Zanstra curves are lessened in the remaining cases. The curves obtained by plotting the theoretical "saturation" current values against the specific gravity of the air do not display the definite breaks indicated before. [See also Abstract 3203 (1938).] Authors.

***4896. Background Effect in Tube Counters. H. Osterwisch.** *Phys. Zeits.* 39. *pp.* 661–665, *Sept.* 15, 1938.—Using a portable apparatus, the background count of tube counters of different dimensions was examined in a salt mine of depth greater than 1000m. water equivalent. Measurements were made on different days. The background was found to be constant under conditions of normal working of the counter to $10^{-4}$Nsec$^{-1}$ cm.$^{-2}$ or to about 1·6% of the average count inside 10cm. of Pb. This corresponds approximately to 0·7% of the normal radiation from the earth's surface. F. C. C.

***4897. Counting Losses in Geiger-Müller Counter Circuits and Recorders. H. Lifschutz and O. S. Duffendack.** *Phys. Rev.* 54. *pp.* 714–725, *Nov.* 1, 1938.—The counting losses due to the finite recovery time of Geiger-Müller counter circuits and recorders are investigated. A description and critique of several experimental methods are given. The parallel method reported here gives the most accurate results. By this method the counting losses in a system consisting of a Geiger-Müller counter coupled by means of a Neher-Harper circuit to a scale-of-one recorder were determined. The method compares the counts registered by the scale-of-one against those registered by a vacuum tube scale-of-128 in parallel with it. The resolution times of both the scale-of-one and the G-M, Neher-Harper combination are thus found. The theoretical equations of Ruark and Brammer and Aloaglu and Smith are verified. The

limitations and applicability of the Schiff-Volz formulation are also determined. Departures from the Ruark-Brammer formula for the Neher-Harper circuit are found at high counting rates. A corrected formula is derived. The speed of the Neher-Harper type of extinguishing circuit, determined in these experiments, is compared with the maximum counting speed possible with G-M counters. It is found that such circuits already approach the speed of the G-M tube itself. Existing vacuum tube scaling circuits and frequency meters are shown to be already faster than the G-M tube itself. The methods for correcting recorders and counter circuits for counting losses are given. These losses amount to about 20% for a Cenco recorder and 1% for most G-M counters at input rates of 1000 counts per min. The losses increase rapidly with the input counting rate. AUTHORS.

***4898. Counter Circuit for D.C. Mains. C. B. Madsen.** *Journ. Sci. Instruments*, 15. *p.* 373, *Nov.*, 1938.—The diagram and working of a simple counter circuit for d.c. mains, employing two triode valves, is described. The values of the components are given for d.c. mains of 220 V. AUTHOR.

***4899. Production of High-Energy Particles. W. H. Wells.** *J. of Applied Physics*, 9. *pp.* 677–688, *Nov.*, 1938.—A review of the recent progress in the development of extremely high voltages.

***4900. Cyclotron and its Applications. J. Chadwick.** *Roy. Inst., Proc.* 30. 2. *pp.* 398–399, 1938. *Nature*, 142. *pp.* 630–634, *Oct.* 8, 1938. *Abstracts.*—The principles governing the operation of the cyclotron for accelerating ions are discussed and a description is given of the apparatus under construction for Liverpool University. Applications of the cyclotron to physical and biological researches are reviewed. The former researches are directed to the study of atomic nuclei, and the latter to the effect of neutrons on malignant tissues. The use of radioactive elements, produced by the cyclotron, as radioactive indicators in biological investigations is also discussed. R. D.

***4901. Paths of Ions in the Cyclotron. Part I. Orbits in the Magnetic Field. Part II. Paths in Combined Electric and Magnetic Fields. L. H. Thomas.** *Phys. Rev.* 54. *pp.* 580–598, *Oct.* 15, 1938.—Bethe and Rose maintain in a recent letter [*ibid.* 52. *p.* 1254, *Dec.* 15, 1937] and paper [see Abstract 1964 (1938)] that a maximum energy for the beam from a cyclotron is fixed by the incompatibility of the conditions for resonance and focusing when the relativity increase of mass with velocity is taken into account. It is shown in Part I that, while this result holds for a radially symmetrical magnetic field, it is not necessarily true in general ; and that for a field varying with polar angle there is an additional focusing effect. If the relative variation of the field with polar angle is of the order of the ratio of the velocity of the ion to the velocity of light, this focusing effect will compensate the defocusing effect of Bethe and Rose. It is shown further than if this variation has period $\pi/2$, a family of stable periodic orbits exists which are nearly concentric circles. In Part II it is shown that the effects of variation with polar angle of the accelerating electric field and of the magnetic field can be considered as almost independent ; the second-order cross terms between them are without practical effect. Thus the results contained in Part I may simply be superposed on those obtained by other workers. AUTHOR.

***4902. Present-Day Design and Technique of the Cyclotron. F. N. D. Kurie.** *J. of Applied Physics*, 9. *pp.* 691–701, *Nov.*, 1938.—A

description of the methods and application of the cyclotron as developed by E. O. Lawrence and his associates at the Radiation Laboratory, University of California, Berkeley.

*See also* Abstracts 4735, 4789, 4814, 4852, 4973, 5055.

# RADIATION.

## ABSORPTION.

**4903. Colour and Chemical Constitution of Salts of Diphenyl Violuric Acid. S. Prakash and S. Dutt.** *Nat. Acad. Sci. India, Proc.* 8. *pp.* 29–39, *June*, 1938.—Diphenyl violuric acid is pale yellow as solid or dissolved in non-hydroxylic solvents, but the salts produced by adding alkalies or organic bases are intensely violet. This change is shown to be associated with a transition from an oximino-ketonic to a nitroso-enolic molecular structure. Study of absorption spectra and hydrolysis constants of the salts shows that the colour is roughly proportional to the strength of the base involved. C. B. A.

*See also* Abstract 5078.

## COLORIMETRY.

***4904. Artificial Daylight. R. Toussaint.** *Soc. Franç. Élect., Bull.* 8. *pp.* 875–878, *Oct.*, 1938.—The author points out that the first step in the production of an artificial daylight is to argee upon the form of daylight to be imitated. He proposes a spectral distribution midway between that of a clear blue sky and that of an overcast sky. He then describes a form of lamp in which the required spectral distribution is obtained by mixing the lights transmitted through three colour filters, one blue+violet (6 parts), one yellow+green (2 parts), and the third orange+red (1 part). Adjustment to correct proportions in the mixture is effected by means of a photo-cell. J. W. T. W.

*See also* Abstract 4921.

## ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

**4905. Magneto-Optic Rotations of Paramagnetic Ions. S. Steingiser and H. Hyman.** *Am. Chem. Soc., J.* 60. *pp.* 2294–2296, *Oct.*, 1938.—The partial Verdet constants of ferric ammonium sulphate, potassium ferricyanide and potassium ferrocyanide were determined and found to be equal to $-1{\cdot}024$, $-2{\cdot}354$ and $+0{\cdot}148$, at molalities $0{\cdot}0282$, $0{\cdot}173$ and $0{\cdot}415$, respectively. The total Verdet constant for each of these molalities was found to be $0{\cdot}01253$, $0{\cdot}00571$ and $0{\cdot}01409$, respectively. The diamagnetic salt, potassium ferrocyanide, shows a normal rotation, while the other salts show a large negative rotation, due to paramagnetism. AUTHORS.

*See also* Abstract 5037.

## EMISSION.

**4906. Definition of the Neutrino. J. Solomon.** *Comptes Rendus*, 207. *pp.* 526–528, *Sept.* 26, 1938.—A mathematical consideration of the interaction of the systems (nucleus+emitted electron) and (neutrino)

indicates that the theory of $\beta$-disintegration implies, not the existence of a new particle or neutrino, but simply a certain number of structural properties of the adjacent system necessary to conserve the total system. N. M. B.

**4907. Researches on Cosmic Rays, 1933-1938. R. Steinmaurer.** *Gerlands Beitr. z. Geophys., Supplementband* 3. *pp.* 38–112, 1938.—Review of recent work in this subject, containing a Bibliography of 1017 references.

**4908. Cosmic-Ray Showers and Bursts. D. K. Froman and J. C. Stearns.** *Rev. Modern Physics,* 10. *pp.* 133–192, *July,* 1938.—This paper is a comprehensive survey of existing experimental knowledge and theoretical deductions therefrom. D. H. F.

**4909. Penetrating Power of Cosmic-Ray Shower Particles. L. Jánossy.** *Cambridge Phil. Soc., Proc.* 34. *pp.* 614–619, *Oct.,* 1938.—The absorption curve for cosmic-ray shower particles has been observed in Pb and Fe with a counter arrangement. Since the observed curves are in good agreement with the absorption curve of cosmic-ray electrons calculated by Heitler, it has been concluded that nearly all the showers are of the cascade type. Observations of Schmeisser and Bothe [see Abstract 2423 (1938)], which have previously been interpreted as giving experimental evidence for the occurrence of penetrating particles in showers are not in contradiction with the observations given here, so that they also must be interpreted in terms of energetic electron cascades. Author.

**4910. Ray Multiplication in Cosmic-Ray Showers. H. Geiger and M. Heyden.** *Zeits. f. Physik,* 110. 5–6. *pp.* 310–319, 1938.—By coincidence-counter experiments it is shown that the mean number of rays in a shower depends in a definite way on the thickness of the lead sheet from which it emerges. The curves obtained indicate that the number of rays in a shower increases considerably with the lead thickness up to 3cm. but with greater thickness slowly decreases. Also with Al layers the initial increase with the layer thickness is established. The Rossi coincidence-curve is discussed in the light of the new results. The increase in the coincidence number up to 1·5cm. Pb is not to be ascribed to an increase in the number of showers but to an increase in the number of rays in a shower. C. J. B. C.

**4911. Energy Loss of Cosmic Rays in Penetrating 9cm. of Gold. P. Ehrenfest, Jr.** *Comptes Rendus,* 207. *pp.* 573–576, *Oct.* 3, 1938.—Measurements were made with a counter-controlled double cloud-chamber, with a 9cm. block of Au between the two compartments, in a magnetic field ; the whole assembly was covered by a 16cm. Pb screen. The energy loss of particles ranging from about $10^8$ eV up to about $10^{10}$ eV was measured The results are briefly discussed. The presence of particles losing little energy in passing through the Au is indicated. It is pointed out that the results are not wholly in accord with those of Blackett and Wilson. [See Abstracts 3071 (1937) and 2856 (1938).] D. H. F.

**4912. Counter Systems for Measuring Cosmic Rays of Very Small Intensity. A. van Gemert.** *Physica,* 5. *pp.* 811–816, *Oct.,* 1938. *In English.*—Two diagrams of counter systems are given for measuring very small intensities of cosmic radiation. The first system was used for measurements in water down to 440m. in a fjord near Bergen, the second system is used for measuring the intensity of the radiation by triple coincidences in a colliery down to 620 m. (about 1600 m. water

equivalent). In the first case a value was obtained with an uncertainty of 8% in 12 hr. at 440m. and in the second case an uncertainty of 4% in 20 days at 500m. (about 1300m. water equivalent). AUTHOR.

**4913. Absolute Intensity of Cosmic Rays at Sea Level. J. Clay and P. H. Clay.** *Physica*, 5. *pp.* 898–900, *Oct.*, 1938. *In English.*—The intensity of cosmic radiation was measured in an ionisation chamber of 28 l. filled with argon at 61 atm., exactly at a level with the surface of the sea in a Norwegian fjord 58° N.L. With the same chamber the intensity was measured in Amsterdam in an iron shield 22 cm. thick underneath and at the sides and 12 cm. at the top. The experiment was carried out in the same shield and in the same place where the absolute intensity was measured before (independent of shape and dimensions of the chamber). The value at sea level for magnetic latitudes $> 50°$ is in argon at 1 atm. and 15° C. $2{\cdot}24 \pm 0{\cdot}06$ I; in air at 1 atm. and 15° C. $1{\cdot}56 \pm 0{\cdot}05$ I with a barometer reading of 770 mm. Hg. For 760 mm. Hg it is 5% more. AUTHORS.

*See also* Abstracts 4844, 4904, 5053.

## FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

**4914. Fluorescent Chromium Ion in Ruby. B. V. Thosar.** *Phil. Mag.* 26. *pp.* 878–887, *Nov.*, 1938. *Supplement.*—Further support is found for the author's idea [see Abstract 4090 (1938)] regarding the physical state of the Cr impurity in ruby, namely, that the fluorescent ions of Cr are regular lattice components and replace a few Al-ions of the corundum lattice. The intense anti-Stokes bands in the spectrum of ruby have been explained as due to the superposition of the vibrational frequencies of the molecular group $Cr_2O_3$, which is thus formed in the crystal. On postulating a weak L-S interaction in the ion and adopting the above structure for ruby, the magnetic dissymmetry in the crystal, in regard to the Zeeman pattern of the sharp lines, has been explained. The validity of the inner quantum number J and the spin-multiplicity have been discussed. Two sharp lines at 7017 and 7049 Å, hitherto unexplained, are shown to arise from the transitions between the newly determined $^4P$ levels of CrIV and the $^4F$ levels. AUTHOR.

*See also* Abstract 4923 and
3547B. Low Pressure Mercury Discharge within Luminescent Tube. W. Uyterhoeven and G. Zecher.
3548B. Fluorescence and Phosphorescence. J. H. Gisolf and W. de Groot.
3549B. Light Production by Luminescent Materials. A. Rütternauer.

## INTERFERENCE, DIFFRACTION AND SCATTERING.

***4915. Photographic Photometry of Interference Fringes. J. Roig.** *Rev. d'Optique*, 17. *pp.* 177–192, *May, and pp.* 217–238, *June–July*, 1938.—A detailed exposition of the principles of photographic photometry as applied to such problems as the study of interference fringes. The author uses for calibrating his emulsion a light source which is varied in intensity by means of a polarising prism and analyser. The various sources of error are dealt with *seriatim* in detail. Details are also given of the monochromator used for the work. J. W. T. W.

***4916. Diffraction by Irregular Gratings. R. W. Ditchburn.** *Roy. Irish Acad., Proc.* 44A. *pp.* 123–138, *July*, 1938.—The properties of gratings in which the distance between successive lines is not constant,

but is a multiple of some fundamental length, are discussed. It is suggested that some gratings of this type may be of practical importance, because with such gratings it is possible to obtain a ratio of resolving power to lines ruled which is considerably higher than the corresponding ratio for equal space gratings. If the irregular grating is well designed this increase in resolving power does not involve the production of large secondary maxima or cause any other unfavourable changes in the properties of the grating. The system is specially applicable to echelon diffraction gratings. Two designs for echelon diffraction gratings and one for a ruled grating are given. The general problem of design is also discussed. AUTHOR.

## PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

**4917. Mercury Photosensitised Decomposition of Ethane. E. W. R. Steacie, W. A. Alexander, and N. W. F. Phillips.** *Canad. J. of Research*, 16. *Sect. B. pp.* 303–318, *Sept.*, 1938.—[See also Abstracts 1998 and 4077 (1938).]

**4918. Competition of Predissociation Processes in the Photolysis of Polyatomic Molecules. G. K. Rollefson and M. Burton.** *J. Chem. Phys.* 6. *pp.* 674–679, *Nov.*, 1938.—It is shown that if a photo-activated polyatomic molecule may decompose in more than one way with different products for each path, certain generalisations govern the probability of an activated molecule decomposing by any given path. First, there is a tendency to form those products which require a minimum amount of the activation energy to appear as kinetic energy. This tendency increases with increase in energy of the molecule if the energies at which the different paths become possible are widely separated but the opposite effect is found if the separation is small. The effects of collisions in causing predissociation is shown to be interpretable partially as an alteration of the number of times that the molecule reaches a condition represented by the intersection of two hypersurfaces and partially as a disturbance of the restrictions existing at such crossings. These principles are applied in a discussion of the photolyses of acetone, acetaldehyde, acetic acid, formic acid, and normal butyraldehyde. [See also Abstract 3679 (1938).] AUTHORS.

**4919. Photolysis of $ND_3$. M. Burton.** *J. Chem. Phys.* 6. *pp.* 680–681, *Nov.*, 1938.—In order to avoid theoretical objections to the mechanism previously suggested for the photolysis of $ND_3$, a new mechanism is proposed involving competition between two spontaneous predissociation processes in the discrete region. The relative amounts dissociating by the two paths, one yielding H and the other $H_2$, are shown to be in the approximate ratio 19 : 1 in the primary act. In the diffuse region, the time of decomposition is so short that the reaction is exclusively by the first path. AUTHOR.

*See also* Abstracts 4925, 4973.

## PHOTOMETRY.

**4920. Theory of the Luminous Field. A. Gersun.** *R.G.E.* 44. *pp.* 307–312, *Sept.* 10, 1938.—Blondel's criticisms [see Abstract 181 (1938)] of the theory of the luminous field are refuted. *Reply by* **A. Blondel** (*ibid.*, *pp.* 312–317).

**4921. Problems of Photometry and Colorimetry. J. Dourgnon.** *Soc. Franç. Élect., Bull.* 8. *pp.* 887–898, *Oct.*, 1938.—Outlines the principles of photometry and shows how the problem of heterochromatic measure-

ments is solved by the use of the international visibility (luminosity) factors. In colorimetry the I.C.I. system is explained and the standardisation of a hypothetical observer's characteristics is shown to provide a basis for a universal system of colour measurement. The hue-and-saturation system is also described. J. W. T. W.

***4922. Photometry of Projection Apparatus at Short Distances. A. Marsat and P. Cibié.** *Soc. Franç. Élect., Bull.* 8. *pp.* 869–874, *Oct.*, 1938.—Describes the application of the method of photometry of projectors proposed by Blondel [see Abstract 3543 (1929)]. This involves the use of a converging lens or mirror of long focal length and of a diameter slightly greater than that of the projector to be measured to throw an image of the projector on a screen placed a short distance away. By the use of a screen perforated with a small hole it is possible to examine the appearance of the projector as seen from a point corresponding to the position of the hole but placed at a much greater distance from the projector. In other words, the appearance of the projector at long ranges can be simulated at a short range by means of this device. The application of the method to motor-car headlights is described, both for the case in which a converging lens is used and that in which a concave mirror is employed to form the first image. J. W. T. W.

***4923. Automatic Intensity Recorder for Photon Counters. M. Kato.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 817. *pp.* 981–990, *Sept.*, 1938. *In English.*—Describes a photon counter developed for use in investigating the phosphorescent properties of the alkali halide phosphors where a high speed of counting and a long recording apparatus is required. The equipment combines the Wynn-Williams automatic counter with the principle of frequency measurement. Time delays consequent upon the use of photographic recording are avoided by using a spark recorder. The range of the apparatus can be adjusted between several counts per min. and 250 counts per sec. E. O. T.

*See also* Abstracts 4915, 5079.

## POLARISATION.

**4924. Relative and Absolute Configuration of Complex Tridiammino-Ions of Trivalent Cr, Co and Rh. F. M. Jaeger.** *Göttingen Nachrichten, Fachgruppe III.* 1. 20. *pp.* 199–213, 1937.—Data are given of an investigation into the optical rotation of solutions of a large number of complex tridiammino-ions of trivalent Cr, Co and Rh. Curves are given showing the relation of molecular rotation to wave-length. The results are discussed in relation to the spatial configuration of the ions. J. I.

**4925. Photodichroism of Cyanine. S. Nikitine.** *Comptes Rendus*, 207. *pp.* 462–464, *Sept.* 5, 1938.—The theory previously given [see Abstract 2875 (1938)] is tested by exposing to white light cyanine in collodion deposited on plates. The dichroism and absorption were measured by monochromatic light near the maximum of the absorption band. The results agree with theory, $\epsilon$, the measure of the anisotropy of the absorption, being about 0·3. H. G. C.

***4926. Polarisation Microscopy with Bravais Double-Plates of Cellophane. H. Pfeiffer.** *Kolloid Zeits.* 85. *pp.* 49–52, *Oct.*, 1938.—The replacement of the polarising nicol commonly used in polarisation microscopy by an apparatus consisting of cellophane foils used like Bravais' double-plates is described. The apparatus is of use in determining the

double refraction of biological material, and its variation with temperature. A. J. M.

***4927. Polarising Microscope for Investigating Prepared Jewels. W. Maier.** *Zeits. f. Instrumentenk.* 58. *pp.* 457–458, *Nov.*, 1938.—A description is given of a special type of polarising microscope used in the examination of jewels set in rings. Sectional drawings illustrate its use. It serves as an alternative to the instrument used in mineralogy and petrography. R. S. R.

*See also* Abstract 4930.

## REFLECTION, REFRACTION AND DISPERSION.

***4928. Dioptrics of Aiming Telescope. H. Schulz.** *Zeits. f. Instrumentenk.* 58. *pp.* 452–455, *Nov.*, 1938.—Formulæ are derived for the constructional data by which the focal length and distance of the individual systems are determined depending upon the magnification, size of building, field of view, etc. According to the choice of the main conditions different groups of values are given which cannot always be brought into agreement with one another. R. S. R.

**4929. Glass Estimation for Achromatic Lenses. H. Schulz.** *Zeits. f. Instrumentenk.* 58. *p.* 412, *Oct.*, 1938.—It is shown that in determining the constants of an achromatic combination the refractive index of one glass is given as the root of a quadratic equation whose coefficients must be evaluated with considerably greater accuracy than usual, so that five-figure logarithms are in general not sufficiently accurate. A. W.

**4930. Birefringence of Quartz under Compression and its U.V. Dispersion. G. Bruhat and A. Blanc-Lapierre.** *Rev. d'Optique*, 17. *pp.* 137–160, *April*, 1938.—Three cases were investigated (1) compression parallel to the optic axis, propagation of light perpendicular to it (2) compression perpendicular, propagation parallel to the optical axis (3) compression and propagation normal to each other and to the optical axis. In case (2) the birefringence is about 28% less than in (1) and (3). In case (3) the effect is independent of the orientation of the pressure in relation to the electric axes. The dispersion agrees with Havelock's formula only to a first approximation. H. G. C.

**4931. Refraction, Dispersion, and Related Properties of Pure Hydrocarbons, Arranged for Use in the Analysis of Hydrocarbon Mixtures. A. L. Ward and S. S. Kurtz, Jr.** *Indust. and Engin. Chem.* (*Analytical Edition*), 10. *pp.* 559–576, *Oct.* 15, 1938.—The data tabulated are (1) boiling point at 760 mm. (or 10 mm.); (2) density $d_4^{20}$; refractive index $n_D^{20}$; (3) dispersion $n_F - n_C$ and two derived constants; (4) the refractivity intercept, $n - d/2$ (88); and (5) the specific dispersion $(n_F - n_C)/d$ (155). These are first tabulated in detail for ten classes of hydrocarbons; tables containing averaged data for specified boiling ranges are then presented, and graphs are drawn based on these averaged properties. A few graphs are also presented showing the relationship between density and refractive index for groups of paraffin and olefin isomers. Authors.

***4932. Lens Testing Bench. J. L. Houghton and E. W. H. Selwyn.** *Journ. Sci. Instruments*, 15. *pp.* 367–373, *Nov.*, 1938.—A lens bench is described which is suitable for the visual examination of photographic lenses of focal lengths from 0 mm. to 150 mm. over fields of view up to a total angle of 90°. In the middle of the bed, which is of channel

section, is a turntable supporting the nodal slide and lens support. No means are at present provided for centring the lens under test, which is examined in the position it will occupy when mounted on a camera. The turntable is mounted on a ball-bearing cone. The microscope is coupled to the turntable by a T-bar which provides an automatic flat-field mechanism. The microscope is mounted upon slides of kinematic design, and its movements are controlled by two micrometer screws. The microscope tube is "bent" for ease of observation by the interposition of a stainless steel mirror. A set of parfocal objectives for use without cover glasses is provided. A micrometer, the range of which is extended by the use of gauge rods, is used to measure equivalent and back focal lengths, the end of the T-bar being used as reference point. The testing and adjustment of the various components is described in detail. AUTHORS.

*See also* Abstracts 4922, 4927, 4947, 4967, 5037, 5078.

## SPECTROSCOPY.

**4933. Fine Structures of Hα and Dα Under Varying Discharge Conditions. R. C. Williams.** *Phys. Rev.* 54. *pp.* 558–567, *Oct.* 15, 1938.—The fine structures of Hα and Dα have been observed under varying conditions of excitation in the discharge tube with pure $H_2$ and pure $D_2$ maintained in each case at near liquid-air temperature, and with the aid of a Zeiss triple-prism spectrograph and a pair of Hilger quartz interferometer plates. The interference patterns obtained upon the photographic plates were analysed with a Moll microphotometer. The microphotometer curves were reduced to intensity curves and to linear dispersion curves in the usual manner. From the final reduced curves analyses were made of the intensities and positions of the fine structure components. Within the limits of error of the observations the positions of the fine structure components were found to be invariant with changing discharge conditions. The average interval between the two main components of the complex was found to be $0{\cdot}319\text{cm}^{-1}$ for Hα and $0{\cdot}321\text{cm}^{-1}$ for Dα. The second and third most intense components were optically resolved from each other in Dα but not in Hα. The average interval between these components was found to be $0{\cdot}130\text{cm}^{-1}$. According to theory these intervals are respectively $0{\cdot}328\text{cm}^{-1}$ and $0{\cdot}108\text{cm}^{-1}$. [See Abstract 5049 (1938).] AUTHOR.

**4934. Isotope Effect in Line Absorption Spectrum of Uranyl Nitrate. G. Joos and B. Duhm.** *Göttingen Nachrichten, Fachgruppe II.* 2. 9. *pp.* 123–126, 1936.—The displacements of absorption lines of $UO_2(NO_3)_2{\cdot}6H_2O$ due to replacement of H by D are measured at temperatures of 20°Abs, and 83°Abs. All lines are displaced towards shorter wave-lengths by 2Å on the average. The separation of about $718\text{cm}^{-1}$ between homologous lines of individual groups remains unchanged. This frequency is ascribed to the $(UO_2)^{++}$ ion. The distances between lines of a given group decrease to a small extent, the separations between lines are ascribed to a vibration between the $(UO_2)^{++}$ ion and the neighbouring $H_2O$ molecule. A common blue displacement of all lines is observed due to change of temperature from 20° to 83°Abs. All observed displacements are much smaller than in the case of chrome alum previously investigated by the authors [see Abstract 196 (1936)] in which the absorption was due to an atomic ion. J. E. K.

**4935. Infra-Red Absorption of Atmospheric Water Vapour. W. M. Elsasser.** *Monthly Weather Rev.* 66. *pp.* 175–178, *June*, 1938.—

This continues previous work [see Abstract 1185 (1938)]. Having given an expression for the intensity distribution in a spectral line the author proceeds to find an expression for the fractional absorption due to a single spectral line in a layer of finite thickness. When dealing with the numerical determination of the absorption the spectrum is divided into three parts, (1) from the short end to about $10\mu$, (2) from $10\mu$ to $20\mu$, (3) from $20\mu$ upwards. Each group is treated separately. In regions (1) and (3) the absorption follows a square root law, *i.e.* it is proportional to the square root of the optical thickness measured in gm. of precipitable water. The relationships between wave numbers and logarithms of absorption for these regions are shown by diagram. In the middle region the absorption follows an exponential law. This type is preponderant in the spectral range covered by atmospheric radiation. A. E. M. G.

**4936. Near Infra-Red Spectrum of Cadmium. O. Masaki and K. Kobayakawa.** *Hirosima Journ. Sci.* 8. *pp.* 289–291, *Aug.*, 1938. *In English.*—Using the Eastman new infra-red 1-Z plates spectrograms are obtained of the CdI spectrum which extend the photographically surveyed region from 10,000 to 12,000 Å. All the lines observed, save a few attributable to Cd II, are classified into series. A. H.

**4937. Long-Wave Infra-Red Spectrum of Quartz-Mercury Lamps. B. Koch.** *Ann. d. Physik*, 33. 4. *pp.* 335–358, *Oct.*, 1938.—The long wave infra-red spectra of different types of Hg lamps have been measured using laminar gratings and the effects (i) of operating conditions on radiation intensity and (ii) of the grating characteristics on the intensity distribution in the spectrum have been investigated. Transmissivities of molten quartz from 220-450$\mu$ and of LiF from 220-360$\mu$ have been determined. The absorption of Hg radiation by a second Hg arc, the emission of a Hg arc in relation to black-body emission, and the initial nature of the radiation are discussed. W. R. A.

**4938. Hyperfine Structure of Os Lines. T. Kawada.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 653–655, *Aug.*, 1938. *In English.*—The h.f.s. of 3 OsI lines $\lambda\lambda 4420{\cdot}6$, $4261{\cdot}0$ and $4135{\cdot}9$ having a common $d^6s^{25}D_4$ level is measured with a Lummer plate and Fabry-Perot etalon. The spectrum being excited in a water-cooled Schüler hollow kathode tube. The observed structures are ascribed to the separated lines of the even isotopes of Os, namely $Os^{192}$, $Os^{190}$, $Os^{188}$ and $Os^{186}$ together with two components due to $O^{189}$. From the intensity and separation of the components ascribed to $O^{189}$ it is concluded that this isotope has a nuclear moment of $I = \frac{1}{2}$ or $\frac{3}{2}$, the former value being the more probable. J. E. K.

**4939. Wave Functions and Potential Curves for Excited $H_2$. A. S. Coolidge and H. M. James.** *J. Chem. Phys.* 6. *pp.* 730–734, *Nov.*, 1938.—Results on wave functions and energy values for the $1s\sigma 2p\sigma^3\,\Sigma_u$ and $1s\sigma 2s\sigma^3\,\Sigma_g$ states of $H_2$, obtained by a variational method, are given. The nuclear separations considered range from $1{\cdot}3a_H$ to $2{\cdot}9a_H$. The errors in the computed energies for the $^3\Sigma_u$ state are of the order of $0{\cdot}001$ atomic unit, while the computed energies for the $^3\Sigma_g$ state are in general more accurate. Root-mean-square errors in the wave functions are of the order of 2%. AUTHORS.

**4940. Extension of Theory of Complex Spectra. G. H. Shortley and B. Fried.** *Phys. Rev.* 54. *pp.* 739–748, *Nov.* 1, 1938.—This paper extends the tabular and formular material of the theory of complex spectra to configurations involving $f$ and $g$ electrons. In making these computations it was found that in practically every case significant

simplification could be made over the methods previously used. In particular, for the computation of the electrostatic energies for two-electron-like almost-closed-shell configurations a simple closed formula was found which entirely replaces the previous lengthy diagonal-sum calculation. The explicit content of the paper is best exhibited by listing the section headings: (I) Extension of tables of $c^k$, $b^k$, and $a^k$ to $gp$, $gd$, $gf$, $gg$; (II) explanation of the regularities in the electrostatic energies of two-electron configurations and formulæ for $gp$, $gd$, $gf$, $gg$, $g^2$; (III) formula determining the electrostatic energies of two-electron-like configurations with almost-closed shells; values for $p^5g$ and $d^9g$; (IV) matrices for transformation of $pf$, $df$, $pg$, $dg$ from LS to $jj$ coupling; (V) matrices of electrostatic interaction in $jj$ coupling for $p^5f$, $(d^9p)$, $d^9d$, $d^9f$, $d^9g$. AUTHORS.

**4941. Structure of Configurations of High Azimuthal Quantum Number in Cu II and Rare Gases. G. H. Shortley and B. Fried.** *Phys. Rev.* 54. *pp.* 749–753, *Nov.* 1, 1938.—The energy levels of configurations such as $d^9f$, $d^9g$ of Cu II and $p^5d$, $p^5f$ of the rare gases are split into two widely separated groups by the spin-orbit interaction of the almost closed shell. These groups have the two levels of the parent doublet as limits. The splitting within these groups is due to the small electrostatic interaction between the core and the outer electron and the spin-orbit interaction of the outer electron. It is found that if one neglects all of these except the leading term in the electrostatic interaction, the theory predicts that all levels should be double, two levels of different J value having the same energy. It further predicts definitely, without unknown constants, all details of the relative arrangement of these energy levels in the two groups. In the rare-gas configurations and Cu II $d^9f$, the levels tend to occur in these pairs and follow this arrangement approximately but the interactions which are neglected in this picture are not entirely negligible. Knowledge of the simple limiting structure should nevertheless be of value in such cases. Cu II $3d^95g$ however fits the simple picture in all details; the levels are observed to occur in pairs with precisely the energies predicted. Thus the 20 levels of this complex configuration are represented by simpler formulæ and with better agreement ($0{\cdot}20$ cm$^{-1}$. average discrepancy) than in any other case which has been treated theoretically. AUTHORS.

**4942. Infra-Red Spectrum and Structure of Glasses. F. Matossi.** *Helv. Phys. Acta,* 11. 6. *pp.* 469–471, 1938. *In German.*—Reference is made to previously recorded investigations [see Abstract 2032 (1938)], and the structure of glasses is discussed. For the atomic structure of quartz-glass and possibly for all melted crystal glasses the following picture may prove true: Small quasi-crystalline regions exist which are connected to each other by transition zones, in which zones the network view may hold good, yet not for the whole structure. The network hypothesis of Zachariasen may then hold if a quasi-crystalline structure is assumed. On one hand the rejection of the extreme network hypothesis is supported by X-ray investigations. On the other hand fluorescence observations show that an extreme crystallite structure is impossible since crystals and glasses actually possess different fluorescence spectra. J. J. S.

**4943. Vibrational-Rotational Radiation Transitions in Water Molecules in Non-Polar Solvents. J. W. Ellis and E. L. Kinsey.** *Phys. Rev.* 54. *pp.* 599–601, *Oct.* 15, 1938.—The $1{\cdot}875\mu(\sigma + \delta)$ and $1{\cdot}379\mu(\sigma + \pi)$ absorption bands of $H_2O$ molecules in $CCl_4$ and $CS_2$

solutions and the $1{\cdot}985\mu(\sigma + \pi)$ band of $D_2O$ in $CCl_4$ are presented. They are interpreted as indicating free rotation of water vapour-like molecules in solution. The dominant feature of each band is an enhanced $Q$-branch. The authors are unable to decide to what extent this enhancement is caused by a possible departure from the usual rotational distribution characteristic of vapours and to what extent by possible alterations in transition probabilities. [See also Abstract 3589 (1937).] AUTHORS.

**4944. Infra-Red and Raman Spectra of Ethane. B. L. Crawford, Jr., W. H. Avery and J. W. Linnett.** *J. Chem. Phys.* 6. *pp.* 682–685, *Nov.*, 1938.—The Raman and infra-red spectfra of ethane have been re-examined. The 993, 2900, and 2955 $cm^{-1}$. Raman lines are polarised; there were indications of very faint lines appearing at 620 and 820 $cm^{-1}$. The strong infra-red peak at 1480 $cm^{-1}$. is found to be a *single* minimum; the weak band at 1740 $cm^{-1}$. is confirmed. The available Raman and infra-red data are evaluated, and possible assignments discussed. It is shown that the observed frequencies do not require a 740 $cm^{-1}$. fundamental, but are consistent with an "uncertain frequency" of about 1100 $cm^{-1}$. and a high restricting potential. [See Abstract 2463 (1938) and following Abstract.] AUTHORS.

**4945. Infra-Red and Raman Spectra of Allene. J. W. Linnett and W. H. Avery.** *J. Chem. Phys.* 6. *pp.* 686–691, *Nov.*, 1938.—The infra-red absorption spectrum and the Raman spectrum of allene were examined. In the infra-red nine bands were observed at 4200, 2960, 2420, 1980, 1700, 1389, 1165, 1031 and 852 $cm^{-1}$. and in the Raman effect there were ten individual shifts of 3062, 2992, 2858, 1956, 1684, 1430, 1069, 838, 705 and 353 $cm^{-1}$. With the aid of heat capacity data it was possible to assign values to the frequencies of all the eleven fundamental modes of vibration of allene. The assignment accounted for all the features of the Raman and infra-red spectra. Calculations were made of the free energy, the entropy and the heat capacity and expressions for the first two, as functions of temperature, derived. [See preceding and following Abstracts.] AUTHORS.

**4946. Infra-Red and Raman Spectra of Cyclopropane and Ethylene Oxide. J. W. Linnett.** *J. Chem. Phys.* 6. *pp.* 692–702, *Nov.*, 1938.—The Raman and infra-red spectra of cyclopropane and ethylene oxide have been examined. The infra-red spectra were examined using a KBr prism from 25 to 11$\mu$, a rock-salt prism from 15 to 7$\mu$ and a fluorite prism from 8 to $1{\cdot}5\mu$. Because of the greater dispersion of fluorite more bands than had previously been observed were resolved in the region in which this prism could be used. The nature, symmetry and selection rules of the vibrations of these two molecules are summarised. It was found possible to make a complete assignment of the fundamental frequencies of cyclopropane which accounts for all the features of the spectra. With ethylene oxide it was only possible to make a partial assignment. The frequencies of the corresponding fundamental modes of vibration of the two molecules are compared. On the basis of the frequency assignment described, values for the free energy, entropy and heat capacity of cyclopropane are calculated between 100° and 1000° K. [See preceding Abstract.] AUTHOR.

**4947. Molecular Spectra of Halides of the Iron Group especially FeCl. E. Miescher.** *Helv. Phys. Acta*, 11. 6. *pp.* 463–468, 1938. *In German.*—FeCl shows an 8-group system in its spectrum between 3700 and 3300 Å, only one group of which is completely resolvable. This con-

tains 6 intense bands forming the (0,0) band, and other bands of $\Delta v = 0$ sequence. The weaker adjacent bands represent the sequences $\Delta v = \pm 1$, $\pm 2$. FeBr gives one band system (3750–3600 Å) which is observed also in the spectrum of $FeBr_2$ vapour. The vapours of $FeCl_2$, $CoCl_2$ and $NiCl_2$ show isolated absorption continua in the near u.v., and an increasing absorption in the far u.v. $NiCl_2$ shows no decrease of absorption when examined at temperatures between 800° and 1000° at constant pressure, and the absorption is therefore due to the triatomic molecule. In $FeCl_2$, however, a second absorption maximum is observed at short wave-length. This is probably due to a dissociation process. W. R. A.

**4948. Influence of Temperature on Absorption Spectra of Solid Solutions of Samarium. O. Blank.** *Acta Physicochimica*, 9. 1. *pp.* 103–110, 1938. *In English.*—An absorption band of Sm IV, $\lambda = 422$ m$\mu$, not perceptible at low temperatures, was detected in borax solutions at 250° C. This band can be interpreted as a transition from the excited level of Sm IV $^6H_{7/2}$. The difference in the frequencies of the absorption bands of Sm IV, 422 and 403 m$\mu$, is in good agreement with the difference between the frequencies of the two most refrangible fluorescence bands. A strong broadening of the absorption bands of Sm and Nd with a rise in the temperature was detected. Author.

***4949. U.V. Absorption Spectra by Reflection. T. Guilmart and R. Freymann.** *Rev. d'Optique*, 19. *pp.* 199–202, *May*, 1938.—An arrangement is described, embodying a quartz spectrograph and hydrogen tube, for studying by reflection the absorption spectra of organic substances in the solid state. Difficulties were encountered owing to polarisation and the aberration of lenses, but when these were eliminated, good results were obtained. F. S.

**4950. Visible and U.V. Absorption of Mineral Oxides and of their Hydroxides and Hydrates. A. Berton.** *Comptes Rendus*, 207. *pp.* 625–627, *Oct.* 10, 1938.—Visible and u.v. absorption bands of solid mineral oxides are displaced towards higher frequencies by the presence of water of hydration or of constitution. Data are given for 17 oxides and their corresponding hydrated compounds. C. B. A.

**4951. Absorption Spectra of Methyl Methacrylate and its Polymer. J. W. Goodeve.** *Faraday Soc., Trans.* 34. *pp.* 1239–1244, *Oct.*, 1938.—On heating, liquid methyl methacrylate polymerises to a glass-clear solid. The former was examined as a pure liquid and in solution of hexane containing 0·00001 to 0·02 gm. mol./l.; in both cases identical spectra were obtained. Discs of the polymer, prepared by methods which are described, were examined. By using special cells, round which water at the desired temperature flowed, the changes in the spectrum during polymerisation have been followed. The characteristics of the extinction coefficient curves are discussed. W. R. A.

**4952. Partial Analysis of Infra-Red Absorption Spectra of Organic Molecules in Dilute Solution. R. Wulf and L. S. Deming.** *J. Chem. Phys.* 6. *pp.* 702–711, *Nov.*, 1938.—An attempt is made to resolve into component parts a number of relatively complex infra-red absorption coefficient curves for several OH-containing organic molecules in the region of the first overtone absorption of the OH group. Such analyses suggest certain relations between the structure of the molecule and its effect upon the character of the absorption of the absorbing group. Authors.

**4953. Negative Bands of $N^{14}$—$N^{15}$. R. W. Wood and G. H. Dieke.** *J. Chem. Phys.* 6. *pp.* 734–739, *Nov.*, 1938.—The negative

bands of nitrogen were photographed with a mixture which contained about 15% of $N^{15}$. The $0 \rightarrow 0$, $1 \rightarrow 0$ and $0 \rightarrow 1$ bands of the $N^{14} — N^{15}$ molecule were analysed. Their position is within the limits of experimental errors where the elementary theory of the isotopic shifts predicts them. The bands do not show any intensity alternations and there are no perturbations at the places where the corresponding bands of ordinary nitrogen have them. AUTHORS.

**4954. Pressure Effect in the 2590 Å Band of MgH. A. Guntsch.** *Zeits. f. Physik*, 110. 9–10. *pp.* 549–552, 1938.—A pressure arc taking 0·8 A. at 3000 V was used as source, the pressure being 3 atm. Nearly twice as many lines were found in the 2590 Å band as had been observed previously in absorption. The bands only appear at higher pressure, and the rotation constant F gives them their characteristic appearance. F. S.

**4955. Predissociation of Sulphur. M. Désirant and B. Rosen.** *Physica*, 5. *pp.* 870–874, *Oct.*, 1938. *In French.*—Remarks on the discussion between W. Lochte-Holtgreven and E. Olsson [see Abstract 2898 (1938)] concerning the predissociation occurring in the band spectrum of $S_2$. It seems that the predissociation at $v' = 10$ is a natural one. AUTHORS.

**4956. Infra-Red Study of Acid Amide and Oxime Association. A. M. Buswell, W. H. Rodebush and M. F. Roy.** *Am. Chem. Soc., J.* 60. *pp.* 2444–2449, *Oct.*, 1938.—Infra-red absorption has been studied for a number of acid amides and oximes. Association due to H-bonding is observed and in the case of monosubstituted amides association is accompanied by a considerable amount of enolisation. Attention is called to the striking similarity of the absorption due to association in the substituted amides and that due to the peptide group in gelatin. [See following Abstract.] AUTHORS.

**4957. Infra-Red Study of Complex Formation Due to Hydrogen Bonding. A. M. Buswell, W. H. Rodebush and M. F. Roy.** *Am. Chem. Soc., J.* 60. *pp.* 2528–2531, *Oct.*, 1938.—The tendency of HCl and $CHCl_3$ toward complex formation with ether and other substances through H-bonding has been investigated. These two compounds stand at opposite extremes in the scale of activity of the H. The rule of Venkateswaran has been verified for the shift of the fundamental frequency of the H. An absorption band which shifts to shorter wave-lengths upon bond formation has been observed in the case of $CHCl_3$ and this absorption has been ascribed tentatively to the second harmonic perpendicular vibration of the H. [See preceding Abstract.] AUTHORS.

**4958. Absorption Spectra of Aromatic Hydrocarbons. T. Förster.** *Zeits. f. phys. Chem.* 41. *Abt.B.* 4. *pp.* 287–306, 1938.—The theory of the origin of the u.v. absorption bands of benzene is extended to other aromatic hydrocarbons built up of phenyl rings. In a number of cases, qualitative discussion of the positions of the essential molecular energy states leads to correct conclusions. By a simplification of the usual quantum-mechanical treatment, the positions of the absorption bands of more complicated polyphenyl systems can be predicted with reasonable accuracy. C. B. A.

**4959. Band Envelopes of Unsymmetrical Rotator Molecules. Part I. Calculation of Theoretical Envelopes. R. M. Badger and L. R. Zumwalt.** *J. Chem. Phys.* 6. *pp.* 711–717, *Nov.*, 1938.—Since the majority of molecules of chemical interest are too heavy to

permit resolution of the rotational structure of the infra-red bands, it is of interest to find what information can be derived from a study of the band envelopes. Considerations of the type which Gerhard and Dennison have made for symmetrical molecules have been extended to the unsymmetrical rotator. By the use of an approximation method the envelopes of the three elementary types of band have been calculated for nine different sets of molecular parameters. AUTHORS.

**4960. Calculation of Frequencies of Symmetrical Modes of Vibration for Molecules with Various Types of Symmetry. H. J. Bernstein.** *J. Chem. Phys.* 6. *pp.* 718–722, *Nov.*, 1938.—The secular equations for the frequencies of the symmetrical modes of vibration for molecules with various types of symmetry have been developed. The types of symmetry considered include a centre of symmetry, and twofold, threefold, and fourfold axes of symmetry. Application to the problem of the configuration of oximes indicates that acetoxime has the following structural formula: 126° $CH_3$, $CH_3$, $C = N - OH$. AUTHOR.

**4961. Molecular Potential Curves from Spectroscopic Data. A. S. Coolidge, H. M. James and E. L. Vernon.** *Phys. Rev.* 54. *pp.* 726–738, *Nov.* 1, 1938.—The problem of determining accurately a molecular potential curve from spectroscopic data on the system is analysed, and the difficulties are discussed in detail. In general the principal difficulty arises from the importance in the energy expression of terms in high powers in the quantum numbers ; to deal with this, recourse may be taken to a method employing graphical integration. Formulæ based on the first order of the W.B.K. approximation are usually but not always adequate. One can obtain markedly better results in determining potential curves by dealing directly with the energy levels which it is desired to reproduce, rather than by the usual method of making the curve reproduce a limited number of spectroscopic constants. A method of successive approximations has proved to be particularly effective in giving accurate results. Formulæ are given for the convenient manipulation of potential curves of the types suggested by Morse, Pöschl and Teller, Hylleraas, Dunham, and also a generalisation of the Morse curve. This last curve has proved to be most satisfactory, combining great flexibility with relative ease of manipulation ; explicit solutions for vibrational wave functions are not obtainable for it, however. The discussion is illustrated by extensive computations on the lowest $^3\Sigma_g$ state of $H_2$, for which a potential curve very accurate in the range of nuclear separations $1{\cdot}3 \leqslant r \leqslant 2{\cdot}9\, a_H$ is obtained. AUTHORS.

**4962. Systematics of Band-Spectral Constants. Part IV. C. H. D. Clark and J. L. Stoves.** *Faraday Soc., Trans.* 34. *pp.* 1324–1328, *Nov.*, 1938.—The results of calculation of equilibrium internuclear distance from vibration frequency for di-atoms have been compared with experimental numbers. The paper is chiefly concerned with a comparison between the method devised by Huggins, based upon a modified Morse potential energy function, and the formula we have proposed. It is pointed out that in both cases allowances have been made in assigning constants not only for the periods and groups involved, but also for the nature of the atoms concerned, in such a way that the question of electron configuration essentially enters in. The authors' formula appears to be

the most generally suitable proposal so far put forward for calculating internuclear distance, when both reliability of the results and speed with which approximations can be made are considered. This work shows that the correct interrelation of the two magnitudes concerned ($\omega_e$ and $r_e$) involves constants which are very sensitive to structural changes. [For Parts I–III see Abstract 5356 (1937).] AUTHORS.

**4963. Zeeman Effect in Spectrum of Neon. J. B. Green and J. A. Peoples, Jr.** *Phys. Rev.* 54. *pp.* 602–605, *Oct.* 15, 1938.—Measurements on about 250 lines of the spectrum of Ne in fields of 27,000–32,000 gauss have now been completed. The Ne discharge was excited by means of an electrodeless h.f. discharge (about 40 megacycles) at right angles to the magnetic field and to the line of sight. The lines, extending from about 3100–9000 Å include transitions involving all of the levels of the $2p^5 4p$, the $2p^5 3d$, $2p^5 4d$ configurations, and parts of others. A large number of "forbidden" lines also appear. Sampson's calculations for the parameters of the $2p^5 3d$ configuration and Shortley's for the parameters of the $2p^5 4d$ configuration have been used to calculate the $g$-values. The agreement between theoretical and experimentally determined values is excellent. AUTHORS.

**4964. Raman Spectra of Molybdic Acid and Molybdates in Aqueous Solution. M. Théodoresco.** *Comptes Rendus*, 206. *pp.* 753–754, *March* 7, *and* 207. *pp.* 531–532, *Sept.* 26, 1938.—The Raman spectra of molybdic acid, (*i*), neutral sodium molybdate, (*ii*), ammonium molybdate, (*iii*), and sodium paramolybdate, (*iv*), have been examined in aqueous solution. Three frequencies 313, 839 and 987 $cm^{-1}$., the latter two forming a doublet, are shown by (*ii*). This spectrum, which is similar to that of the $SO_4''$ ion, is due to the $MoO_4''$ ion. The spectrum of (*iii*) shows six displacements, of which two (938 and 892 $cm^{-1}$.) also form a doublet analogous to that observed in (*ii*), and is due to the $Mo_7O_{24}''$ ion. The spectrum of (*iv*) is identical with (*iii*), and that of (*i*) is characterised by a triplet 950, 901 and 853 $cm^{-1}$., of which 853 $cm^{-1}$. has no corresponding displacement in the salts. W. R. A.

***4965. G.E.C. Recording Spectrophotometer. J. L. Michaelson.** *J.O.S.A.* 28. *pp.* 365–371, *Oct.*, 1938.—Some of the problems, and their solutions, encountered in the production of a commercial spectrophotometer are discussed. In its final form the instrument comprises two sections, (*a*) the photometer and (*b*) the monochromator and recorder. Amongst other advantages this makes the two sections separately available for other purposes. The various component mechanisms are described at length. [See following Abstract.] A. H.

***4966. Calibration and Operation of the G.E.C. Recording Spectrophotometer. K. S. Gibson and H. J. Keegan.** *J.O.S.A.* 28. *pp.* 372–385, *Oct.*, 1938.—The spectrophotometer [see preceding Abstract] installed at the National Bureau of Standards has certain features not found on the commercial form. The wave-length scale is longer, finer slits are used, cams are available for plotting on a log or log log scale, higher voltages are applied to the valves, and a variable capacity is included in the output impedance of the amplifier. The effect of these changes on the working of the instrument is described, and the various errors encountered are discussed. [See preceding Abstract.] A. H.

*See also* Abstracts 4843, 4850, 4914, 4972, 4976, 5049.

## VISION.

***4967. Vision through Optical Instruments. T. Smith.** *Phys. Soc., Proc.* 50. *pp.* 863–887, *Nov.* 1, 1938. *Presidential Address.*—No new results are presented but a number of topics of interest to opticians and teachers are discussed. These include the teaching of geometrical optics, the curvature method and vision through instruments. The extension of the elementary theory to systems not having symmetry about an axis is also discussed, as is its application to simple instruments. A. H.

## X-RAYS.

**4968. Azimuthal Intensity Distribution of X-Rays. K. Böhm.** *Ann. d. Physik,* 33. 4. *pp.* 315–334, *Oct.*, 1938.—In order to verify some earlier work by Kulenkampff (*ibid.* 87. 4. *p.* 597, 1928) on the distribution of intensity in azimuth of X-rays scattered from Al-foil $0{\cdot}6\mu$ thick, the experiments have been repeated with Mg-foil of thickness less than $0{\cdot}1\mu$. The foils were prepared by evaporation on to celluloid films. By the use of thin foils, the effects of diffusion and the loss of velocity are minimised. In the various regions of measurement, investigations were carried out on (1) the dependence of the azimuthal intensity distribution on the wave-length at constant tube potential (for 20, 31 and 40 kV); (2) the dependence on the potential for the existing limiting wave-lengths, and (3) the dependence on the potential for a constant wave-length (0·65 Å). The distribution curves obtained show a marked asymmetry, in agreement with the earlier results. The agreement of the distribution curves with theory, for a wave-length region near the limiting wave-length, is good as far as the positions of the maxima and the shapes of the curves are concerned. G. O. B.

**4969. X-Ray Scattering at Small Angles. K. Alexopoulos and S. Peristerakis.** *Phys. Zeits.* 39. *pp.* 688–690, *Oct.* 1, 1938.—The primary assumptions made in calculating the theoretical angular distribution of scattered X-rays are that the conduction electrons are completely free and that they have no temperature gradient. These assumptions are not fulfilled in reality, so that a variation from the theoretical curve is to be expected in the experimental results at small angles. Such a result is obtained with Be in this paper in the angular range for which $(\sin\theta/2)/\lambda$ lies between 0·013 and 0·054. The difference between the experimental curve and the theoretical curve is in the expected direction. Some of the variation can be explained by temperature effect while some is possibly due to the influence of the crystal lattice. G. O. B.

**4970. Estimation of X-Rays Incoherently Scattered by Gases. K. Hoffmann.** *Phys. Zeits.* 39. *pp.* 695–706, *Oct.* 15, 1938.—Up to the present the magnitude of the modified X-rays scattered by matter has had to be calculated theoretically. An account is here given of experimental measurements. The modified and unmodified radiation were separated by means of suitable filters, whose properties were investigated. Absolute measurements were made of both the modified and unmodified intensities for $CO_2$, using WL$\alpha_1$ and WL$\beta_2$ radiation. The results obtained show that the total intensity is throughout greater than is to be expected from the original theory. For example, with $\mathrm{Sin}\ \delta/_2/\lambda = 0{\cdot}60$ the value obtained was 35 Thomson units, while the theoretical value is only 27 units. The result of the measurements made with monochromatic radiation, that the ratio of the unmodified to the modified intensity is greater than is to be expected theoretically, is thus

substantially supported. The possibility cannot, however, be excluded of some systematic error affecting mainly one of the components. The measurements with $CO_2$ show that it is possible to separate the two parts of the scattered radiation and to measure them with sufficient accuracy. This result is important from an application point of view. It also appears that for $CO_2$ the outer electrons are not satisfactorily represented by present theory. Whether this is concerned with the effect of the bound electrons or with a poor approximation to the charge distribution may be decided by experiments on the rare gases, which call for improved technique. The method of determining the intensities of both parts of the scattered radiation is, however, an important contribution to the study of the finer problems of electron distribution, for which measurements of the total intensity alone were quite insufficient.

A. W.

**4971. Scattering and Photoelectric Absorption of H.V. X-Rays in Nitrogen. H. C. Trueblood and D. H. Loughridge.** *Phys. Rev.* 54. *pp.* 545–554, *Oct.* 15, 1938.—A study of the expansion chamber tracks of 810 kV X-radiation passing through $N_2$ shows that the angular distribution of total electrons emitted is in good agreement with the Klein-Nishina formula when allowance is made for the presence of photo-electrons. The latter are distinguished from recoils by the criterion of the maximum Compton energy. Electrons having energies greater than the Compton energy for the corresponding angle of emission were classified as photoelectrons while those having smaller energies were either photo- or recoil electrons. The ratio of recoils to photoelectrons is of the order of 100 in contrast to the theoretical value of about 5000. The angle of bipartition for photoelectrons is about 48° for 360 ekV and about 20° for 650 ekV photoelectrons. AUTHORS.

**4972. Intervals of X-Ray Spin-Doublets. G. Araki and S. Noma.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 746–754, *Sept.*, 1938.—The intervals of the X-ray spin-doublets are calculated for the *L*, *M*, and *N* terms of Cl, K, Ca, Cu, Rb and Cs atoms, on the basis of the Breit Hamiltonian. The eigenfunctions used in the computations involve the Hartree or the Hartree-Fock radial functions. The agreement between the calculated and the observed values is satisfactory in general. [See also Abstract 4053 (1937).] AUTHORS.

**4973. Effects of Radiation on Oil. W. Stenstrom and I. Vigness.** *Am. J. of Roentgenology and Radium Therapy*, 40. *pp.* 427–433, *Sept.*, 1938.—Chemical reaction is produced by radiation—commonly oxidation and, less frequently, reduction—different types of radiation causing different effects. X-rays produce ionisation but this is relatively very small and difficult to measure. In order to measure these minute changes the authors utilise oil drops on water, the spread of which is proportional to the number of acid molecules present so that, if X-rays cause oxidation of the oil, the size of the drop increases subject to other factors such as impurities of the water which modify the spread. This effect has been studied with a trade oil "Bacol." The method has been applied in two ways, viz. irradiation of the oil in test tubes or when spread in drops on water. The effect has been demonstrated for X-rays, $\beta$-rays and short wave u.v. rays, detailed data and curves being given in respect to the experimental work. The effect of temperature has been studied. The effects increase with dose administered but no difference has been observed with X-rays produced at 100 and 200 kV. Twice the dose was required

to produce changes in oil spread on water, as compared with oil irradiated in test tubes. With heavy X-ray doses change occurs in the absorption spectrum, indicating oxidation and unsaturation of the oil. B. J. L.

**4974. Influence of Elastic Anisotropy on X-Ray Measurement of Strain. R. Glocker.** *Zeits. f. techn. Physik*, 19. 10. *pp.* 289–293, 1938.—The elastic anisotropy of polycrystalline iron, as measured by X-ray methods, is considered in relation to the angle of incidence of the X-ray beam. The values obtained by X-rays are compared with those obtained by calculation and it is found that the assumption of the free and independent extension of the constituent single crystallites is not justified. J. T.

***4975. Concave-Grating Vacuum Spectrograph for Wave-Lengths 15 to 1000Å. F. C. Chalklin, S. S. Watts and S. P. Hillson.** *Phys. Soc., Proc.* 50. *pp.* 926–933, *Nov.* 1, 1938.—A vacuum spectrograph for work with soft X-rays is described. It employs a 1-m. concave grating in the grazing-incidence position. The instrument is designed to permit the optical system to be adjusted before it is placed in the vacuum chamber, so that trial-and-error focusing may be minimised. It makes provision for varying the grazing angle without any necessity for readjustment. Tests of the instrument are described and discussed. AUTHORS.

*See also* Abstract 5050 and

3479B. X-Ray Tube for Analysis of Crystal Structure. J. E. de Graaf and W. J. Oosterkamp.

# HEAT.

## CALORIMETRY.

**4976. Nuclear Spin and Symmetry Effects in the Heat Capacity of Ethane Gas. E. B. Wilson, Jr.** *J. Chem. Phys.* 6. *pp.* 740–745, *Nov.*, 1938.—The heat capacity of ethane gas has been calculated for a number of values of the internal potential barrier from zero to high barriers. Detailed account of the presence of noncombining species and of the exact nuclear spin statistical weights was taken. It was found that down to temperatures at least as low as 90°K. these phenomena are entirely unimportant and that the partition function calculated in the usual way is correct. It is concluded that the observed experimental data are best explained by the assumption of a high restricting potential. Tables of statistical weights for the rotational levels of $C_2H_6$ and $C_2D_6$ are given. [See Abstract 2576 (1935).] AUTHOR.

**4977. Specific Heat of Water ($H_2O$) Between 0° and 100° C. W. A. Roth.** *Zeits. f. phys. Chem.* 183. *Abt.A.* 1. *pp.* 38–42, 1938.—The calculations of Fiock and Jessel are critically considered. After suitable weighting the author obtains the most probable formula for the true specific heat of light water between 0° and 40° C. as $C = 1{\cdot}0066 - 0{\cdot}00056696\theta + 0{\cdot}000008742\theta^2$. $C_{0°C} = C_{100°C}$, and the minimum of 0·9974 appears at about 35°C. D. R. H.

**4978. Heat Capacity of Bi. H. L. Bronson and L. E. MacHattie.** *Canad. J. of Research*, 16. *Sect. A. pp.* 177–182, *Sept.* 1938.—The mean heat capacity of Bi over 10° intervals has been determined from — 80° to 120° C. by means of adiabatic electrical heating in a copper jacket. The maximum deviation of any individual point from a smooth curve

is 0·1%, and the error in the absolute values obtained is considered to be not more than 0·1%. No discontinuities or irregularities were found; in fact, the experimental results are represented to within the limits of experimental error by the linear equation : $C_p = 0{\cdot}1238_5 + 4{\cdot}45 \times 10^{-5}t$, where $t$ is the Centigrade temperature, and the units are joules/gm./°C. The equation : $C_v = (D/209{\cdot}0)\ (119/T) + 3{\cdot}99_7 \times 10^{-7}T^{1{\cdot}703}$ was found to fit the mean experimental curve as closely as the graph could be read (0·02%). $T$ is the absolute temperature and $D(119/T)$ the Debye function for $C_v$ per mole. $C_p$ is given in joules/gm./°C. A calculation of $C_p$ from non-thermal data gives values about 3% low. AUTHORS.

**4979. Specific Heats and Heat of Fusion of $TeCl_4$. K. J. Frederick and J. H. Hildebrand.** *Am. Chem. Soc., J.* 60. *pp.* 2522–2523, *Oct.*, 1938.—Employing the method of mixtures, the heat of fusion of $TeCl_4$ at the melting point was found to be 4510 ± 30 cal./mol., the molal heat capacity of solid $TeCl_4$ in the interval 25–224·1°, 33·1 ± 0·3 cal./mol., and the molal heat capacity of liquid $TeCl_4$ in the interval 224·1–265°, 55·0 ± 0·5 cal./mol. AUTHORS.

**4980. Low-Temperature Heat Capacity Measurements on $BF_3$, $CF_4$ and $SF_6$. A. Eucken and E. Schröder.** *Zeits. f. phys. Chem.* 41. *Abt.B.* 4. *pp.* 307–319, 1938.—The molal heats of $BF_3$, $CF_4$ and $SF_6$ (at intervals of 5° from 12° K. up to temperatures above the melting points) together with the heats of fusion and transition have been determined. An adiabatic vacuum calorimeter was employed. The transition in $CF_4$ at 76·23° K. is sharp and is probably due to a change in the rotational state of the molecules. In $BF_3$ the transition occurred at 142·15° K. which is just below the melting-point 144·46° K. The transition in $SF_6$ at 94·3° K. is peculiar in that the transition is sharp on cooling but not on heating. From vapour-pressure data obtained by others and the calorimetric data, the authors have calculated the entropies (at 298·2° K. and 1 atm. pressure) of the three fluorides. The statistically determined entropies are shown to be in close agreement with those values. S. W.

**4981. Latent Heat of Fusion of Aluminium. J. H. Awbery.** *Phil. Mag.* 26. *pp.* 776–784, *Nov.*, 1938. *Supplement.*—The extremes among the published values for the latent heat of fusion of Al differ by about 50%, and the results fall into two groups, one with a mean about 92 cal./gm. and one about 77 cal./gm. A method has been used in which the electrical energy required to melt a known mass is measured, and it gives a result of 91 cal./gm. The various low values in the literature are attributed to impurities or to inherent inaccuracies in method. It is suggested that the most probable value is 92·4 ± 0·5 cal./gm. AUTHOR.

*See also* Abstract 4994.

## CONDUCTION.

*See* Abstract 4994.

## DILATATION.

**4982. Expansion of Crystals in Relation to their Structure. H. D. Megaw.** *Zeits. f. Krist.* 100. 1. *pp.* 58–76, 1938. *In English.*—Expressions are derived for the coefficient of thermal expansion of non-metallic crystals in terms of their structure and interatomic forces. For homodesmic crystals (atoms linked to their neighbours by forces of the same kind throughout the whole structure) an empirical rule is put forward that the mean linear expansion coefficient is approximately proportional

to the electrostatic share. Those crystals which depart from this rule are discussed individually and anisotropy of expansion is also discussed. J. I.

**4983. Dilatometric Anomalies in Cu-Al Alloys. A. Boutillier.** *Comptes Rendus*, 207. *pp.* 498–500, *Sept.* 19, 1938.—The author has previously pointed out that alloys with 7–16 parts Cu per 100 Al have certain dilatometric anomalies which are due neither to changes of density nor to plasticity changes [see Abstract 5195 (1936)]. From tests made with a Chevenard dilatometer on alloys of about 12 parts Cu per 100 Al the author concludes that these anomalies classified previously as unexplained are of a special type dependent upon the rate of cooling adopted in cooling down the specimen from above 580°. The dilatometric aspect of these anomalies is irregular, for both the sign and order of the anomalies vary considerably, rapid cooling for example producing an increase in length whereas slow cooling produces a contraction. S. W.

## FUSION AND SOLIDIFICATION.

**4984. Intensity of Orbital Interaction in Transition Elements. R. Forrer.** *J. de Physique et le Radium*, 9. *pp.* 387–392, *Sept.*, 1938.—Modifications in the author's theory [see Abstract 4595 (1937)] necessary to explain the very high melting points of some transition elements (*e.g.*, Ru, Ta, W, etc.), and the allotropic modifications of Ti and Zr, are described. The approximate identity of the melting point of He and the temperature at which supraconductivity occurs is stressed, and it is suggested that both are connected with the lattice of *s* electrons. C. A. S.

**4985. Cryoscopy in Saline Solutions. E. Cornec and H. Muller.** *Comptes Rendus*, 207. *pp.* 578–580, *Oct.* 3, 1938.—The crysoscopic curves of molecular lowering *versus* concentration, $\Delta/c$, for aqueous solutions usually become curved as concentration decreases, so that the results of extrapolation to zero concentration become indefinite. If instead of $H_2O$ a solution of *e.g.* $KNO_3$ of constant concentration is used the curves become straight lines, but $\Delta_0$ for $c = 0$ for various electrolytes bears no simple relation to $\Delta_0$ for a non-electrolyte, *e.g.* urea. If the solution used, however, be of that concentration in $KNO_3$ which with the added electrolyte is eutectic, the molecular lowering for $c_0$ of the added electrolyte does bear a simple ratio, which depends on the number of foreign ions (*i.e.*, in this case other than $K^+$ or $NO_3^-$) added. Several actual results are given in illustration. [See Abstract 3816 (1932).] C. A. S.

*See also* Abstract 5000.

## TEMPERATURE.

*See* Abstract 4980.

## THERMOCHEMISTRY.

**4986. Heat Contents of Salts of Alkali Metals in Extremely Dilute Aqueous Solutions. T. F. Young and P. Seligmann.** *Am. Chem. Soc., J.* 60. *pp.* 2379–2383, *Oct.*, 1938.—The method applied by Young and Groenier [see Abstract 1756 (1936)] to the heats of dilution of aqueous NaCl solutions has been extended to all other salts of the alkali metals for which sufficient data are available for the application of the least square technique. The average value of the limiting derivative, $S^0$, for eleven salts of the 1–1 valence type at 25° and $S^0/3^{3/2}$ for five salts of the 1–2 valence type is about 30% larger than the average of the older estim-

ates based upon an assumed linear relation between the apparent molal heat content and the square root of the concentration. The new average agrees with the theoretical value calculated from Wyman's dielectric constant measurements and the Debye-Hückel limiting law. Since the calculated values of $S^0$ appear to confirm the Debye-Hückel limiting law and Wyman's measurements a second set of derivative equations have been derived in which $S^0$ was fixed at the theoretical value. AUTHORS.

**4987. Heats of Combustion of Anthracite Cokes and of Artificial and Natural Graphites. P. H. Dewey and D. R. Harper.** *Bureau of Standards, J. of Research*, 21. *pp.* 457–474, *Oct.*, 1938.—There have been determined the heats of combustion of 30 samples of anthracite coke of known different temperatures of preparation (900° to 1300° C.), H contents (0·08 to 0·78%), and adsorptive capacities (0·13 to 37·5 $cm^3$. of gaseous $CO_2$ per gm. of solid carbon), in order to study the effect of these properties on the energy content of the material. Data were also obtained on the heats of combustion of two samples of pure ash-free artificial graphite and four different samples of natural graphite. The heats evolved, expressed in international kilojoules, for the combustion of 1 mole of solid carbon to form $CO_2$, at 25·0° C. and a pressure of 1 atm., without the production of external work, are as follows: Artificial graphite No. 0, 393·39 $\pm$ 0·17; artificial graphite No. 1, 393·25 $\pm$ 0·15; Ticonderoga natural graphite, 393·32 $\pm$ 0·11; Buckingham natural graphite, 393·35 $\pm$0·13; Baffin Island natural graphite, 393·37 $\pm$ 0·26; and H-free anthracite coke, 403·03 $\pm$ 0·29 (obtained by linear extrapolation to zero H content of the data on the H-containing cokes). AUTHORS.

**4988. Heats of Combustion of Diamond and of Graphite. R. S. Jessup.** *Bureau of Standards, J. of Research*, 21, *pp.* 475–490, *Oct.*, 1938. —Measurements were made of the heats of combustion of one artificial graphite, two natural graphites, and two samples of diamond. The bomb calorimeter used was calibrated electrically and by means of benzoic acid. The amount of reaction in each combustion experiment was determined from the mass of $CO_2$ formed. This method of determining the amount of reaction automatically eliminates the effect of unburned C and of some impurities. It was found, however, that results for different samples did not agree unless the samples were purified. Two methods of purification were used: (*a*) Heating *in vacuo* to 1800° C., and (*b*) treatment with HCl and HF and subsequent heating *in vacuo* to 200° C. to remove traces of the acids. Both methods yielded graphite containing only small amounts of impurities. The mean value obtained for the heat of combustion ($-\Delta H$) of the purified graphites in $O_2$ at 25° C. and a constant pressure of 1 atm. to form gaseous $CO_2$ at the same temperature and pressure was 393·396 international kj./mol. (44·010 gm. of $CO_2$). The maximum deviation of the mean value for any one of the purified samples from this value was 0·021%. The two samples of diamond, purified by treatment with aqueous HCl and HF and subsequently heated *in vacuo* to about 570° C., had average particle sizes of 2·5 $\mu$ and 39·5 $\mu$ respectively, and yielded the following respective mean values for the heat of combustion ($-\Delta H$) at 25° C. and 1 atm., in $O_2$ to form gaseous $CO_2$: 395·771 and 395·287 international kj./mol. The difference between the two values, which is several times the estimated uncertainty of the measurements, is in proper direction to be accounted for on the basis of particle size, but the first sample appears to be not fine enough to account quantitatively for the difference. AUTHOR.

**4989. Heat and Free Energy of Formation of $CO_2$, and of the Transition between Graphite and Diamond. F. D. Rossini and R. S. Jessup.** *Bureau of Standards, J. of Research*, 21. *pp.* 491–513, *Oct.*, 1938.—There are reviewed the existing data on the entropies of $O_2$, $CO_2$, graphite, and diamond, and those on the heats of combustion of natural and artificial graphite and of diamond, including the results recently obtained in a joint investigation by the National Bureau of Standards and the Coal Research Laboratory of the Carnegie Institute of Technology. The new thermochemical data are combined with values of the entropies to obtain values for the heat and free energy of formation of $CO_2$, and for the transition between graphite and diamond. For C (*c*, graphite) + $O_2$ (*g*) = $CO_2$ (*g*), at 25° C., per mole, $\Delta H^\circ = -393{,}355 \pm 46$ NBS international joules, or $-94{,}030 \pm 11$ cal., and $\Delta F^\circ = -394{,}228 \pm 58$ NBS international joules, or $-94{,}239 \pm 14$ cal. For C (*c*, graphite) = C (*c*, diamond), at 25° C. and 1 atm., $\Delta H = 1899 \pm 124$ joules, or $454 \pm 30$ cal., and $\Delta F = 2872 \pm 129$ joules, or $686 \pm 31$ cal. For this transition, the following equation is derived, with some approximations, for the range T = 273° to 1400° K., and P = 0 to 20,000 atm.: $\Delta F = 541{\cdot}82 + 6700/T + 1{\cdot}17662\ T \log T - 2{\cdot}43723\ T - 0{\cdot}000221\ T^2 - [0{\cdot}045660 + 0{\cdot}91236 \times 10^{-3}\ T - 0{\cdot}7830 \times 10^{-10} T^2 - 0{\cdot}3623 \times 10^{-12} T^3]\ P + 0{\cdot}19 \times 10^{-6} P^2$ cal./mol. (In all of the foregoing values, conversion from the NBS international joule to the conventional calorie is made with the factor 1/4·1833.) AUTHORS.

**4990. Fundamental Oscillations in Burning Gas Mixtures. G. Guderley.** *Zeits. f. angew. Math. u. Mechanik*, 18. *pp.* 285–308, *Oct.*, 1938.—The oscillations produced when a gas mixture burns in a closed cylindrical vessel are studied mathematically with respect to origin, growth and decay, and particularly as regards the influence of pressure. The case of the combustion velocity when independent of pressure is also investigated. The various differential equations are derived, and the influence of the oscillations on entropy distribution discussed. It is shown from two extreme examples that the internal thermal exchange need not be considered for the final result; but that the influence of pressure on combustion velocity is of supreme importance. A procedure is given for determining the form of the fundamental oscillations in the heterogeneous gas distribution. H. H. Ho.

**4991. Special Solutions for the Motion of Powder Gas. R. H. Kent.** *J. of Applied Physics*, 9. *p.* 734, *Nov.*, 1938.—A correction of a statement made in the original. [See Abstract 4792 (1936).]

**4992. Explosive Processes. W. Jost and L. v. Müffling.** *Zeits. f. phys. Chem.* 183. *Abt. A.* 1. *pp.* 43–54, 1938.—The customary formal treatment of explosive processes with its convenient mathematical formulation of an infinite velocity of reaction in series explosions is briefly discussed and shown to lead to certain inconsistencies. Semenoff's formal expression for the velocity of reactions [see Abstract 2226 (1928)] is considered to be invalid in complicated cases, more especially as the expression permits an infinite value of the velocity. A modification of the expression for the velocity, which does not permit an infinite value is suggested. The explosion of Knall-gas is discussed in considerable detail from the points of view of these two equations, account being taken both of processes interrupting the series of reactions and of side reactions. J. S. G. T.

*See also* Abstract
3483B. Dust Explosions. W. Gliwitzky.

## THERMODYNAMICS.

**4993. Phase Integrals and Thermodynamics. K. Husimi.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 757–769, *Sept.*, 1938.—The physical bearing of the Bernstein-Widder theorem concerning the Laplace integral is discussed in connection with the statistical expression of the Planck characteristic function. The result is a partial perfection of the Boltzmann-Gibbs procedure of constructing the fundamental formalism of statistical mechanics. The result of the foregoing investigation is that there exists only a very weak connection between thermodynamics and statistics; the logarithmic convexity, which the author opines to exhaust all the thermodynamic requirements, follows from the complete monotony but not inversely. The so-called thermodynamic statistics of Einstein and others appear only to be valid when no higher terms than the quadratic are retained in the expansion of S. H. H. Ho.

**4994. Molecular Theory of Gases. Part II. M. Trautz.** *Die Physik*, 6. 4. *pp.* 163–180, 1938.—The first part of this work appeared some time ago [see Abstract 4983 (1933)]. This paper is a review of the literature dealing with statistical models, equilibrium conditions, specific heats and chemical constants, transport processes, viscosity, thermal conduction, diffusion, temperature drop etc. A large number of references is included. E. H. D.

**4995. Thermal Hysteresis in HBr Transformations. A. Eucken and W. Güttner.** *Göttingen Nachrichten, Fachgruppe II.* 2. 14. *pp.* 167–180, 1937.—In a previous paper [see Abstract 298 (1937)] the transformation of $CH_4$ has been investigated and here similar experiments on HBr at 89°Abs. are described. The experimental details are given in full and include two methods, one using ultrasonics. The results are given graphically and their theoretical significance is discussed at length. E. H. D.

**4996. Persistence of Liquid State of Aggregation above the Critical Temperature. R. L. McIntosh and O. Maass.** *Canad. J. of Research*, 16. *Sect. B. pp.* 289–302, *Sept.* 1938.—The data obtained by Maass and Geddes [see Abstract 4609 (1937)] on the properties of ethylene in the critical-temperature–critical-pressure region have been substantiated although it was shown that a small correction had to be applied to their absolute values of density. It was shown that at the critical density of ethylene the difference between the densities of the medium below and above the point at which the meniscus disappeared was a maximum. The conclusion of Mayer and Harrison [see Abstract 979 (1938)] that, at a temperature just above that at which the meniscus disappeared, the pressure of the system remains constant over a considerable variation of mass per volume, has been corroborated. The effect of the presence of small measured quantities of air has been examined. The phenomena observed are explained on the basis that there is a difference between the gaseous and liquid states of aggregation with a structure assigned to the latter. AUTHORS.

**4997. Low-Temperature Properties of Gaseous Helium. H. S. W. Massey and R. A. Buckingham.** *Roy. Soc., Proc.* 168A. *pp.* 378–389, *Nov.* 7, 1938.—The viscosity and second virial coefficients of He are calculated in the temperature range 0–26°K. using exact quantum formulation and the interatomic interaction given by Slater. It is found that there is very good agreement with the observed viscosity down to 15°K., but below this temperature the calculated values are too small.

The correct form for the variation of the virial coefficient with temperature is obtained, but the calculated behaviour is in error in predicting too low temperatures for the position of the maxima, etc. (The calculated Boyle point is 21° compared with the observed 23°.) It is shown that the discrepancies may be greatly reduced in both cases by small modification of the Slater field involving reduction of the van der Waals force at large distances and inclusion of dipole-quadripole interaction. No difference between the theoretical results obtained by assuming different statistics is sufficiently definite to be distinguished from small errors in the assumed interaction, in the temperature range from 1°K. upward. AUTHORS.

***4998. Compressibilities of $H_2$ and of $H_2 + N_2$ Mixtures. R. Wiebe and V. L. Gaddy.** *Am. Chem. Soc., J.* 60. *pp.* 2300–2303, *Oct.*, 1938.—Previous work since 1930 on the compressibilities of $H_2$, $N_2$ and their mixtures has been summarised. A modified Bartlett compressibility apparatus is described. The compressibilities of $H_2$ and four $H_2$-$N_2$ mixtures have been measured at 0, 25, 50, 100, 200 and 300° and to 1000 atm. AUTHORS.

**4999. Formation of Surfaces in Liquid-Liquid Mixtures. W. W. Lepeschkin.** *Kolloid Zeits.* 85. *pp.* 52–56, *Oct.*, 1938.—The theory of the structure of liquid "precipitates" is considered. In the separation of liquid phases of aqueous molecular solutions, *e.g.*, in the system $(NH_4)_2SO_4$—$H_2O$—EtOH, the interfacial layer of one of the phases (usually the upper one) is formed from molecules of the liquid dissolved in the $H_2O$, which having come sufficiently close together, are held by their mutual molecular attraction. In the above-mentioned system the boundary layer of the upper phase is formed of EtOH molecules. The phenomenon in the case of colloidal solutions is also examined. Here the boundary layer of one of the phases (usually the lower one) is formed of micelles or macro-molecules of the colloid held together by molecular attraction. These micelles contain a good deal of $H_2O$, thus making the phase liquid. It may be described as a micellar liquid in which $H_2O$ is molecularly dissolved. A. J. M.

**5000. Ordering and Transformations in Condensed Phases. F. C. Frank and K. Wirtz.** *Naturwiss.* 26. *pp.* 688–694, *Oct.* 21, *and pp.* 697–705, *Oct.* 28, 1938.—A review dealing with the thermodynamic and molecular treatment of transformations in condensed phases. The thermodynamic classification of such transformations is given, reference being made to the transformation of the second kind with He, and the rotational transformations of $CH_4$ and $CD_4$. The transformations of liquid crystals, superstructural transformations, and the phenomenon of fusion are considered. [*See also remarks by* **M. v. Laue.** *Ibid. p.* 757, *Nov.* 18, 1938.] A. J. M.

*See also* Abstracts 4821, 4980, 5004, 5009.

## VAPORISATION AND CONDENSATION.

**5001. Boiling Point and Chemical Constitution. Part II. Calculation of Degree of Association at the Boiling Point. V. C. E. Burnop.** *Chem. Soc., J. pp.* 1614–1618, *Oct.*, 1938.—In Part I [see Abstract 3323 (1938)] it was shown that the function $(b) = M \log T + 8{\cdot}0\sqrt{M}$, is additive for unassociated compounds, and contributions to $(b)$ of various atoms and structures were evaluated. This function is now

used to calculate the boiling point, T′, which an associated compound should have in the unassociated state ; and, following Walker's generalisation that the molecular weights of related compounds vary approximately as the squares of their absolute boiling points, $(T/T')^2$ is regarded as giving the degree of association. These values are recorded for several classes of compound. AUTHOR.

***5002. Continuous High-Vacuum Still and Boiling-Point Apparatus, and the Systematic Distillation of a Dewaxed Lubricant Fraction of Petroleum. R. T. Leslie and W. W. Heuer.** *Bureau of Standards, J. of Research,* 21. *pp.* 515–533, *Oct.*, 1938.—A sample of lubricant stock having about the properties of light automobile lubricating oil was obtained from a refinery supplied with crude oil from the Oklahoma City field. 240 gallons were distilled through a semi-commercial vacuum still. A continuous high-vacuum laboratory still and an apparatus for determining boiling points were constructed and the material was distilled systematically three times with their aid. After the third distillation, there remained 762 kg. of material which distilled between 135° and 270° C. at 1 mm. Hg. The material tended to concentrate in four boiling ranges. The results of distillation of lubricant and naphtha fractions from a Ponca City petroleum are compared at the same stages. AUTHORS.

**5003. Production of Condensation Nuclei in the Presence of Electrical Charges. G. Tohmfor and M. Volmer.** *Ann. d. Physik,* 33. 2. *pp.* 109–131, *Sept.*, 1938.—A theory of the production of condensation nuclei in the presence of electrical charges is elaborated, which goes beyond the well-known Thomson theory in that it accounts also for the observed variation in the critical expansion ratio with the ion density and the strength of the electric field. The calculation is based on considerations of local fluctuations in density of the water vapour which may cause both agglomeration of water molecules to form a condensation nucleus and also sufficient supersaturation to cause that nucleus to grow to a visible drop. With further assumptions concerning the polarisation of water molecules, fair agreement is obtained with experimental data. The value deduced for the dielectric constant of the condensation nuclei is much less than that of water in bulk. The theory is applied to the production of condensation nuclei during electrolysis at high current densities. F. C. C.

**5004. Equilibria in Two-Phase, Gas-Liquid Hydrocarbon Systems. Part II. E. H. Boomer, C. A. Johnson and A. G. A. Piercey. Part III. E. H. Boomer and C. A. Johnson.** *Canad. J. of Research,* 16. *Sect.B. pp.* 319–335, *Sept.*, 1938.—In Part II the densities and compositions of both phases in the *n*-pentane-methane solubility equilibrium have been determined at 25°, 55°, and 85° C. at total pressures from 35 to 190 atm. The critical pressures of complete miscibility were found. The properties of the system are discussed. Similar measurements at 25° C. and at pressures from 35 to 135 atm. were made on a system composed of a mixture of *n*-pentane and isopentane with methane. In Part III the densities and compositions of both phases in the *n*-hexane-methane solubility equilibrium have been determined at 25°, 55°, and 85° C., at total pressures from 35 to 230 atm. The critical pressures of complete miscibility were found. The properties of the system are discussed. Similar measurements were made on a system consisting of a liquid mixture, principally isomeric hexanes, and methane. [For Part I see Abstract 5044 (1937).] AUTHORS.

*See also* Abstract 4931.

# ACOUSTICS.

**5005. Filtration of Sound. R. B. Lindsay.** *J. of Applied Physics*, 9. *pp.* 612–622, *Oct.*, 1938.—The author reviews the theory of infinite acoustic filters and then proceeds to describe a general theory of transmission through a medium in which there are periodic changes in its properties. The theory is adapted to filters containing a finite number of elements and the calculated transmission characteristics of low-pass and high-pass filters are compared with the results of experiment. Good agreement is obtained. The calculations are extended to cover the case of a filter connected to a finite line, *e.g.*, an acoustic filter connected to a tube of finite length. The formula obtained does not allow of simple deductions being made unless special values are assumed for the resonance of the terminating line. Certain special cases are dealt with, however. J. E. R. C.

**5006. "Transverse" Acoustic Waves in Rigid Tubes. H. E. Hartig and C. E. Swanson.** *Phys. Rev.* 54. *pp.* 618–626, *Oct.* 15, 1938.—Recently considerable work has been done, both theoretical and experimental, on the transmission of electromagnetic waves through dielectric wave guides and hollow metal tubes. An analogous phenomenon is the propagation of transverse acoustic waves in gaseous media confined by rigid cylindrical tubes. Apparatus and methods are described for the production of some of the lower ordered acoustic waves and measurements are made with a tube of circular section filled with air. Measured values of wave-length, threshold frequency, and pressure distribution for some of the possible harmonic wave types are found to be in excellent agreement with theoretical values. Absorption measurements by the standing wave method in which transverse waves are used are suggested. AUTHORS.

**5007. Musical Quality of a Violin. H. Meinel.** *Zeits. f. techn. Physik*, 19. 10. *pp.* 297–307, 1938.—The results of a number of measurements upon violins are given. Response curves are given for several instruments, some modern and some old, and the effect of various changes in their construction is investigated. The effect of changing the thickness of the wood and also of applying varnish is shown in the response curves reproduced. The "dynamik," namely, the ratio between the quietest and loudest tone obtainable, has also been determined for various violins. It is found, however, that the performance of a violin depends so much upon the circumstances in which it is used that there is little possibility of a physical measurement being sufficient to specify the quality. J. E. R. C.

**5008. New Method of Measuring Wave Speeds. S. J. Plimpton.** *Am. Phys. Teacher*, 6. *pp.* 203–205, *Aug.*, 1938.—The use of intensity considerations, which are liable to introduce errors in the measurement of wave-lengths and frequencies, is eliminated by a method depending on the extinction of beats with an adjacent tuning fork. The mathematical basis of the method, and applications, are discussed. N. M. B.

**5009. Velocity of Sound in A and $D_2$ at Liquid $O_2$ and $H_2$ Temperatures. Second Virial Coefficient of Argon. A. van Itterbeek and O. van Paemel.** *Physica*, 5. *pp.* 845–853, *Oct.*, 1938. *In English.*—Measurements were made, using supersonics, on the velocity of sound as

a function of pressure in A at: 90·25, 85·73, 80·85 and 78·93° K. and also in $D_2$ at 20·36° K. The results obtained for A can be represented by the following formula: $W^2 = W^2_0(1 + P \cdot p + Q \cdot p^2)$. From these measurements the second virial coefficient for A was computed between 273° and 80° K. The results are discussed. The authors' preliminary results with $D_2$ are compared with Schaefer's results. [See Abstract 5395 (1937).] AUTHORS.

**5010. Absorption and Velocity of Sound in $H_2$, $D_2$, He and Ne. A. van Itterbeek and L. Thys.** *Physica*, 5. *pp.* 889–897, *Oct.*, 1938. *In English.*—Measurements on the velocity and the absorption of sound by using supersonics have been made in $H_2$, $D_2$, He and Ne between room-temperature and the boiling point of liquid $O_2$. As was observed by other investigators (Abello, Curtis,) the values found for the absorption in $H_2$ and He are not in agreement with theory. For $H_2$, the authors found for the absorption coefficient $a$ ($cm^{-1}$.) a value which is 20 times the classical theoretical value. For $D_2$, the experimental value is a factor 10 too great, for He and Ne respectively a factor 4 and 3. From measurements made at the boiling point of liquid $O_2$ in $H_2$ containing about 1·5% $O_2$, an influence is found on the absorption of transitions occurring between even and odd rotational energy levels. At liquid-$H_2$ temperatures the absorption in $H_2$ becomes very small and seems to agree at this temperature with the classical theoretical value. For the four gases in question, a decrease is found in the absorption coefficient as a function of temperature. For $H_2$ and $D_2$ this decrease seems to be greater than for the two other gases. AUTHORS.

**5011. Absorption Measurements of Supersonic Waves in Aqueous Solutions. W. Buss.** *Ann. d. Physik*, 33. 2. *pp.* 143–159, *Sept.*, 1938.—Investigations were first made of the supersonic sound field using an optical interferometer. The phenomena thus observed gave no means of measuring the sound intensity. For measurement of the absorption from the sound radiation pressure a method based on capacity measurement was found to be particularly suitable on account of its high sensitivity. The variable capacity measured was that of a pendulum disc of metal and cork, suspended by a bifilar suspension and exposed to the supersonic sound waves, and a fixed plate arranged parallel to the suspended one and a short distance away from it. The capacity variations could be very accurately measured by means of the corresponding variations in the anode current of a h.f. valve oscillator. Measurements were made of the absorption of waves of frequencies from 2150 to 6500 kc./sec. in solutions of sugar, glycerin, $MgSO_4$, $Na_2SO_4$, NaCl and $NH_4Cl$ and also in $CCl_4$. The observed increase of absorption in the case of solutions of sugar, glycerin and $MgSO_4$ and the decrease in the case of NaCl and $NH_4Cl$ solutions compared with the value for water is not given accurately by the Stokes-Kirchhoff absorption formula. Comparison of the results obtained is made with those obtained by various investigators. A. W.

**5012. Supersonic Dispersion in Liquids. R. Bär.** *Helv. Phys. Acta*, 11. 6. *pp.* 472–475, 1938. *In German.*—Following upon measurements [see Abstract 5405 (1937)] of supersonic absorption in certain liquids at very high frequencies (50–80 Mc./sec.) the author has measured the velocity of sound in this region of frequency. By comparison with measurements of sound velocity at lower frequencies it may be decided whether supersonic dispersion may be observable. The following results

were obtained for the velocity (m./sec.) of sound in distilled water at 7·5 and at 53 Mc./sec. :—

| T | $V_{7·5}$ | $V_{53}$ |
|---|---|---|
| 19·06° C | 1480·3 | 1480·2 |
| 20·30 | 1483·5 | 1483·1 |
| 24·48 | 1487·55 | 1487·0 |
| 22·70 | 1491·0 | 1490·1 |
| 23·14 | 1492·9 | 1492·2 |

Later and improved measurements did not show discrepancy between the two velocities. J. J. S.

**5013. Excitation of Intramolecular Vibrations in Gases and Gas Mixtures by Collisions. Part V. L. Küchler.** *Zeits. f. phys. Chem.* 41. *Abt.B.* 3. *pp.* 199–214, 1938.—Measurements of sound dispersion were made by a method previously described [see Abstract 4625 (1937)], in $CO_2$, $CO_2$–He, $CO_2$–$H_2$, and $N_2O$–He, at different frequencies, pressures and concentrations, and at temperatures between 20° and 400° C. It was again noted that a uniform period of adjustment holds for the total heat of vibration. With rise of temperature the number of collisions diminishes in $CO_2$–He but is practically constant in $CO_2$–$H_2$ and in $N_2O$–He. A parallel is shown to hold between the total number of collisions and the gross dependence of this on temperature. G. E. A.

**5014. Absorption Effects in Sound-Transmission Measurements. P. E. Sabine and L. G. Ramer.** *Acoustical Soc. of America, J.* 10. *pp.* 102–104, *Oct.*, 1938.—A description is given of measurements of the sound-transmitting properties of a partition set up between two rooms in which the total absorption is varied. It is demonstrated that the ratio of the sound intensities in the two rooms becomes less as the absorption in the receiving room decreases and it is shown that if the correction deduced from the usual formula for the effect of the absorption is made, a constant value for the sound-reduction factor of the partition is obtained as the total absorption in the receiving room is varied over a range of from 7 to 130 units. The significance of this result in connection with the proposed American standards for measuring sound transmission is pointed out. J. E. R. C.

**5015. Harmonic Structure of Vowels in Singing. B. Stout.** *Acoustical Soc. of America, J.* 10. *pp.* 137–146, *Oct.*, 1938.—A study of the changes that take place in the harmonic structure of sustained vowels in singing with (*a*) pitch constant and intensity varied, (*b*) intensity constant and pitch varied. The vowels chosen were *ah*, *oo*, and *ee*, and the results indicate that the most important change in the harmonic structure which accompanies an increase in intensity is an enhancement of the relative importance of the partials which have frequencies greater than 1800. This enhancement is greatest at the low pitch ($D_2$, 146·8) for *ah*, greatest at the high pitch ($D_3$, 293·6) for *ee*, and about the same for all three pitches studied ($D_2$, $A_2$, and $D_3$) for *oo*. The increase in the fundamental which accompanies an increase in total intensity is very slight for *ah*, more for *oo*, and greatest for *ee*. With a rise in pitch, intensity remaining constant, the most important change in the harmonic structure of all three vowels is a decrease in the relative intensity of the partials with frequencies greater than 1800. G. E. A.

**5016. New Method for Determining the Uniaural Differential Threshold. J. W. Hughes.** *Phil. Mag.* 26. *pp.* 635-650, *Nov.*, 1938.—An interrupted note variable in intensity is added to one of fixed intensity and in phase with it at the ear. It is shown that the variation required provides a very open scale at the differential threshold. Three means of obtaining summation of the notes are described, and the accuracy of the the method for ensuring that the notes are in phase is discussed.

AUTHOR.

***5017. Theory of Chromatic Stroboscope. R. W. Young and A. Loomis.** *Acoustical Soc. of America, J.* 10. *pp.* 112–118, *Oct.*, 1938.—The authors describe a development of the chromatic stroboscope [see Abstract 4131 (1937)] so that pitches can be directly read in terms of cents (one cent is 0·01 semitone). The combination of frequencies from a musical chord is applied to a lamp, so that the modulated light falls on a series of 12 stroboscopic discs, each of which has 7 rings of alternate light and dark elements, the illumination, when the discs are rotated at the correct speed, indicating the pitches of notes, if present; likewise flatness or sharpness is indicated. Because of the impossibility of obtaining gear ratios corresponding to the equi-tempered scale, the compromise ratios of 89/84 and 107/101 are adopted to minimise errors, the resultant error in pitch being less than 0·1 cent. The chromatic gear-box is therefore provided with 12 shafts carrying stroboscopic discs at relative speeds corresponding to the scale of semitones within the above error, the whole range of a piano then being covered. The flashing amplifier is provided with automatic gain control; inputs corresponding to the range of 60 db operate the discharge lamp adequately. For measuring mistuning, a calibrated fine adjustment of speed permits measurement within $\pm$ 50 cents, with a sensibility of 1 cent. [See also Abstract 4618 (1938).] L. E. C. H.

**5018. Acoustic Experiments on Fresnel Diffraction. H. K. Schilling.** *Am. Phys. Teacher*, 6. *pp.* 265–269, *Oct.*, 1938.—A description of experiments on sound diffraction using modern equipment. Sound waves of length 2 cm. are passed through slits of width which can be varied between 1 and 12 cm. The source of sound is in a box from which the waves emerge horizontally to be received by a microphone and oscillograph. The microphone can be moved horizontally in a circle. As the width of the slit is increased, the deviation of the first "dark fringe" decreases, the energy in the geometrical beam increases, the number of fringes increases, and the largest number of minima possible for a given slit width $w$ is $w/\lambda$. By using narrow reflecting strips, the effects of destructive and constructive interference are studied. Effects with a double slit, multiple slits, circular apertures and curved reflectors are also examined. In shadow effects the Arago "bright spot" is obtained with a disc 20 to 30 cm. in dia. The term phonoptics is proposed for these experiments. G. E. A.

***5019. Modified Phonodeik. J. E. Shrader.** *Am. Phys. Teacher*, 6. *pp.* 269–271, *Oct.*, 1938.—Description of a phonodeik which requires less skill for its construction than Miller's. The diaphragm is of thin cover glass, and the thin needle used as spindle to carry the mirror is supported by fine tungsten wires ending in fine springs. The effects are shown by means of a rotating mirror operated by a small motor with reduction pulleys. Frequencies up to 3000 have been recorded, and two

records shown give the beats from two tuning forks and the note of a trombone with vibrato. G. E. A.

**5020. Acoustics. Part II. E. Meyer.** *Die Physik*, 6. 4. *pp.* 127–162, 1938.—In continuation of an earlier paper [see Abstract 3842 (1934)] an account is given of recent progress in acoustics. The following sections are dealt with : General acoustics ; methods of measurement and analysis ; electro-acoustics ; music ; building acoustics ; physiological acoustics ; noise measurement and reduction ; supersonics. J. E. R. C.

**5021. Frequency Ratios of the Tempered Scale. C. Williamson.** *Acoustical Soc. of America, J.* 10. *pp.* 135–136, *Oct.*, 1938.—The theory of the tempered scale may present mathematical difficulties to the student of music, and common fractions are more likely to be understood as a means of expressing the frequency ratios of the scale. Helmholtz gave the intervals of the tempered scale in a series of common fractions, and Harker [see Abstract 2739 (1937)] has furnished the decimal equivalents to 8 significant figures. Application of the method of continued fractions brings out that Helmholtz has given one of the convergents in 7 of the 11 cases. It is suggested that the convergents be used in all cases. The table would then read : 89/84, 55/49, 44/37, 63/50, 295/221, 99/70, 442/295, 100/63, 37/22, 98/55, 168/89. The product of pairs symmetrically chosen is 2 in every case. G. E. A.

*See also* Abstract 4751 and
3407B. Voice Frequency Spectrometer. E. Freystedt and F. Bath.

# ELECTRICITY AND MAGNETISM.

## ALTERNATING-CURRENT NETWORKS.

***5022. Relative and True Power Factors of Air Capacitors. A. V. Astin.** *Bureau of Standards, J. of Research*, 21. *pp.* 425–456, *Oct.*, 1938.—An a.c. bridge for measuring the differences of power factor of capacitors to $\pm 5 \times 10^{-7}$ in the commercial and audio-frequency range is described. The bridge is essentially of the Schering type, with a Wagner ground connection, and may be arranged for either high- or low-voltage use. The theory of the bridge is given for both perfect and imperfect balance, the latter permitting evaluation of the error due to residual voltages. Variable low-loss air capacitors for use in the bridge are described. It is shown that the power factor of a guard-ring air capacitor is not necessarily zero, and a method is given for determining the true value of this power factor. AUTHOR.

*See also* Abstracts 4776, 5031, 5043, 5067, 5074.

## CONDUCTION AND DISCHARGE IN GASES.

**5023. Rate of Vaporisation of Mercury from an Anchored Kathode Spot. L. Tonks.** *Phys. Rev.* 54. *pp.* 634–639, *Oct.* 15, 1938.—Two major difficulties which interfere with the measurement of the vaporisation of Hg at a free kathode spot are the spray and the normal evaporation from the free surface. By anchoring the spot the spray has been eliminated, and by a specially designed, water-cooled kathode structure the free surface has been limited to small areas of controllable size.

By means of a calibrated feed mechanism, Hg was fed to the kathode as fast as it vaporised. Measurements were made over a range of arc current, cooling water temperature, and exposed area. The rate of vaporisation (gm./coulomb) increased with arc current, temperature, and exposed area, all due to increased normal evaporation. The rate may also increase with arc current, because of cumulative effects within the spot itself. Extrapolated to zero arc current the rate was found to be approximately $2{\cdot}5 \times 10^{-4}$ gm./coulomb. This lies within the limits set by von Issendorf. It means that eight elementary charges pass through the arc for every atom evaporated. AUTHOR.

**5024. Ionising Radiation Accompanying a Spark Discharge. H. Raether.** *Zeits. f. Physik*, 110. 9–10. *pp.* 611–624, 1938.—It is shown with a cloud chamber that a spark in $H_2$, air or $O_2$ is accompanied by a radiation which ionises the gas. Measurement on the liberated photo-electrons indicates a radiation of 800–1000 Å; its absorption coefficients in the three gases respectively were 2 $cm^{-1}$., 0·8 $cm^{-1}$. and 5 $cm^{-1}$. The characteristics of the radiation indicate that it is identical with that produced in counter discharges. The presence of such a radiation in solar radiation would explain various phenomena associated with the ionosphere. F. C. C.

**5025. Initial Recombination of Ions. L. Onsager.** *Phys. Rev.* 54. *pp.* 554–557, *Oct.* 15, 1938.—The probability that a pair of ions of given initial separation will recombine with each other is computed from the laws of Brownian motion, which is the proper procedure whenever the Langevin factor equals unity, as in gases at high pressures. In the absence of forces other than the Coulomb attraction, the probability of escape equals the reciprocal of the Boltzmann factor. This result includes the correlation between temperature and pressure coefficients of the ionisation by light particles previously predicted by Compton, Bennett and Stearns, if one allows their basic hypothesis about the laws which govern the initial separation of the ions. The effect of an electric field is to increase the fraction of escaping ions by a factor which in the incipient stage of the effect is proportional to the field intensity and independent of the initial distance, although it depends on the orientation of an ion pair. The predicted increase of the ionisation current is a little more than 1% for every 100 V/cm., which accounts for the observed effects of fields exceeding 1500 V/cm. A reasonable amount of columnar recombination would help to explain the proportionately greater effects of weak fields. The inferred initial separations of the ions are apparently compatible with present knowledge of electron scattering and attachment. AUTHOR.

***5026. General Theory of Double-Focusing Mass-Spectrographs. R. Herzog and V. Hauk.** *Ann. d. Physik*, 33. 2. *pp.* 89–106, *Sept.*, 1938.—A formula has been previously derived to express the form of the pole-shoe perimeter necessary to fulfil the double focusing condition in a double-focusing mass-spectrograph comprising a radial electric and a homogeneous transverse magnetic field [see Abstract 2551 (1938)]; the form of the image curve in such a spectrograph is now derived and discussed in detail in relation to the pole-shoe curve. The angle of incidence of rays on the image curve and the dispersion are also deduced. It is shown clearly how in the limit the case of rectilinear pole-shoe and image curves is attained. For a given angle of incidence of rays on the photographic plate the optimum angle of deflection is 120°. An appreciable increase of

dispersion can only be obtained in the case of very oblique incidence of the rays on the plate. J. E. K.

**5027. Effective Cross-Section of Positive Alkali Ions. K. H. Bracewell.** *Phys. Rev.* 54. *pp.* 639–643, *Oct.* 15, 1938.—Determinations have been made of the mean free path and effective cross-section of $Na^+$ ions in $H_2$, $N_2$ and $O_2$. A modified form of the Dempster mass-spectrograph was used over a range of ion velocities from 40 to 400 V. Curves showing the velocity distribution of the ions after passing through the gases indicate that the essential factor in the ion absorption is neutralisation, though some retardation and angular scattering may occur. Over the voltage range observed the mean free paths in $N_2$ and $O_2$ are almost identical. The results for the effective cross-sections show that the effective size of an ion is dependent on its speed ; at high speeds it apparently makes a number of kinetic theory collisions without removal from the beam. The curves turn sharply upwards at speeds less than 50 V, appearing to approach kinetic theory values of the cross-section at zero potential. J. E. R.

**5028. Sputtering of Oxide-Covered Mg Surfaces. R. W. Ditchburn and K. I. Roulston.** *Cambridge Phil. Soc., Proc.* 34. *pp.* 620–624, *Oct.*, 1938.—The rate of sputtering of Mg in $O_2$ was observed with an apparatus which permitted the field immediately in front of the target to be reversed. Change in the sign of the field did not affect the rate of sputtering which remained abnormally low. It is therefore concluded that, while the low rate is in some way due to the presence of an oxide film, it is not due to charged particles being returned to the kathode by the electric field, as had been suggested by other workers. [See Abstract 4153 (1937).] AUTHORS.

*See also* Abstracts 4827, 4895, 4896, 4897, 4898, 4899, 4900, 4901, 4902, 5003.

## CONDUCTION IN SOLIDS AND LIQUIDS.

**5029. Resistance of a Metal at Low Temperatures and Matthiessen's Rule. G. P. Dube.** *Cambridge Phil. Soc., Proc.* 34. *pp.* 559–567, *Oct.*, 1938.—By solving the fundamental integral equation an expression is obtained for the electrical resistance which takes into account, to the first approximation, the mutual influence of the impurities and the lattice vibrations. It is found that deviations from Matthiessen's rule are to be expected and that these deviations are surprisingly large. The formulæ derived only indicate the trend of the resistance curve, but this trend is not confirmed by experiment. Whereas the theory indicates that the mutual influence of the impurities and the lattice vibrations should decrease the electrical resistance, the experimental results of Grüneisen on copper show that, when deviations from Matthiessen's rule occur, the resistance is increased. AUTHOR.

***5030. Stability of Zero of Valve Electrometer Circuit. F. Müller and W. Dürichen.** *Phys. Zeits.* 39. *pp.* 657–661, *Sept.* 15, 1938.—The two essential conditions to be fulfilled in a valve electrometer circuit if a wandering zero is to be avoided are found to be, (1) the smallest possible grid current and, (2) a sufficiently large potential sensitivity. F. C. C.

***5031. Determination of Absolute Ohm, Using an Improved Self Inductor. H. L. Curtis, C. Moon and C. M. Sparks.** *Bureau of Standards, J. of Research*, 21. *pp.* 375–423, *Oct.*, 1938.—A second determination of the value of the absolute ohm has been completed.

The same method as that previously described has been followed. [See Abstract 1313 (1936).] This required the computation of the inductance of a solenoid from its measured dimensions and the electrical measurement of the same inductance in terms of resistance and time. Refinements were made in many of the details of measurement. Two important improvements were introduced. A new inductor was constructed in which the wire was wound in a screw thread of uniform pitch cut in a glass tube. The error in the computed inductance which resulted from the variations in pitch has been practically eliminated, whereas in the previous inductors this introduced one of the largest uncertainties. The other improvement was in the a.c. bridge measurements, where the effect of the capacitance to earth of the inductor was evaluated. The result of this determination is 1 NBS international ohm = 1·000 479 absolute ohms. By estimating the capacitances to earth of the inductors used in the previous work, corrections have been applied to the results there obtained. The weighted average of this result and the corrected results from the previous publication is 1 NBS international ohm = 1·000 468 absolute ohms. The authors are of the opinion that this weighted average differs from the true value by less than 20 parts in a million. AUTHORS.

**5032. Influence of Magnetic Fields on Persistent Currents in a Closed Supraconducting Circuit. K. C. Mann, H. G. Smith and J. O. Wilhelm.** *Phys. Rev.* 54. *pp.* 758–766, *Nov.* 1, 1938.—A study has been made of the effects of external magnetic fields in preventing persistent currents from flowing in a closed supraconducting circuit, in order to determine as closely as possible the field strength at which the first trace of electrical resistance appears. In agreement with earlier work by a less accurate method and with the resistance measurements of de Haas, but in contradiction to the idealised theory of the transition state, it is clearly shown that no resistance appears until the mean magnetic induction within the specimen becomes considerable. It has been found further that the amount of resistanceless current that a cylindrical specimen can carry under these conditions has a well-defined limit. The effects of very small quantities of impurities of different types have also been investigated and have been found greatly to affect the above results. When the persistent current strength was slightly above its equilibrium value, it required a measurable time to decay ; the behaviour was similar to the relaxation effects observed in the study of magnetic and thermal properties of supraconductors. [See following Abstract.] AUTHORS.

**5033. Relaxation Effects Connected with the Transition Between the Supraconducting and Normal States. H. G. Smith and K. C. Mann.** *Phys. Rev.* 54. *pp.* 766–770, *Nov.* 1, 1938.—Several authors have suggested that the relaxation effects frequently observed in experiments on the magnetic properties associated with supraconductivity may be due to the slow decay, caused by a very small resistance, of eddy currents in the specimen. Similar relaxation effects have recently been observed [see preceding Abstract] in experiments on persistent currents in a closed supraconducting circuit. Viewed in the light of a marked parallelism in behaviour of all time effects, these experiments definitely confirm the above suggestion. Further, a simple thermodynamic argument shows that the same cause will produce relaxation in the thermal equilibrium, and so will account also for the time effects in the calorimeter experiments of Keesom and van Laer. [See Abstract 3219 (1937).] AUTHORS.

**5034. Conductance of HCl in Dioxane-Water Mixtures. B. B. Owen and G. W. Waters.** *Am. Chem. Soc., J.* 60. *pp.* 2371–2379, *Oct.*, 1938.—The equivalent conductance of HCl has been measured in 20, 45, 70 and 82% dioxane solutions at 15, 25, 35 and 45°. The experimental data closely follow the Onsager limiting slope in 20 and 45% dioxane solutions at high dilutions. Ionic association is too pronounced in 70 and 82% dioxane for convergence with the limiting slope within the accessible concentration range. In a given solvent mixture, it was shown that the temperature dependence of the limiting conductance is linear, and the variation with viscosity can be expressed by $\Lambda_0\eta_0^s = r(s < 1)$. The effect of the dielectric constant upon conductance and ionic association was illustrated by graphs, and by evaluation of the dissociation constant of HCl in 70 and 82% dioxane solutions. At 25° the estimated values of the dissociation constant are $7{\cdot}7 \times 10^{-3}$ and $2{\cdot}0 \times 10^{-4}$ in 70 and 82% dioxane solutions, respectively. Rough values of the heat and entropy of ionisation were also reported. AUTHORS.

**5035. Conductance of Mixtures of Lead Abietate and Tributyl-Ammonium Chloride in Toluene. V. Deitz and R. M. Fuoss.** *Am. Chem. Soc., J.* 60. *pp.* 2394–2401, *Oct.*, 1938.—The conductances of lead abietate and of tributylammonium picrate and chloride in toluene at 35° have been determined at 60~ by means of the Schering bridge. The polar moment of lead abietate in toluene is zero. Values for the other two salts check values in the literature. The reaction between lead abietate and tributyl-ammonium chloride in aromatic hydrocarbons has been studied. It is suggested that an intermediate soluble mixed salt, PbAbCl, is formed. The moment of the corresponding ion pair is $8{\cdot}6 \times 10^{-18}$ and its dissociation constant is approximately $1{\cdot}5 \times 10^{-17}$. An analytical method for the determination of lead in compounds soluble in aromatic hydrocarbons is described. The method depends on the fact that dry HCl precipitates $PbCl_2$ quantitatively from benzene or toluene solutions of lead salts. The preparation of pure lead abietate is described. AUTHORS.

***5036. Equivalent Circuit of Conductivity Cells. S. F. Acree, E. Bennett, G. H. Gray and H. Goldberg.** *J. Phys. Chem.* 42. *pp.* 871–896, *Oct.*, 1938.—Oscillographic measurements are reported on electrolytes between bright Pt electrodes. The frequencies used were 60 and 240~. It is shown that, so long as the impressed voltage was less than the e.m.f. of polarisation of the solution, the cell was electrically equivalent to a resistance in series with a leaky condenser, and that the component impedances were independent of frequency and voltage. If the impressed voltage exceeded the e.m.f. of polarisation, the capacitance of the equivalent condenser (which is due to the film at the surface of the electrode) increased a great deal. W. H. W.

*See also* Abstracts 4898, 4984, 5067, 5081 and
3392B. New Reflecting Galvanometer. K. W. Kögler.
3399B. Measurement of Small D.C. Potentials. L. Merz.

## DIELECTRICS AND CAPACITANCE.

**5037. Anomalous Dispersion and Free Rotation. A. Budó.** *Phys. Zeits.* 39. *pp.* 706–711, *Oct.* 15, 1938.—This entirely mathematical paper investigates the behaviour of molecules with rotatable groups in the h.f. alternating field and the effect of free rotatability on anomalous dispersion. The axes of rotation in the groups are assumed to be parallel

and all intermolecular effects are neglected. The determination of the average moment in the alternating field requires that of the distribution function, which, in the static field, is assumed to be that of Maxwell-Boltzmann. The refractive and absorptive indexes are determined from a formula (now derived) as a function of the frequency. H. H. Ho.

**5038. Dipole Rotation in Solutions. P. Girard and P. Abadie.** *Phys. Zeits.* 39. *pp.* 691–692, *Oct.* 1, 1938.—Dispersion and absorption curves obtained for propyl alcohol and solutions of propyl alcohol in hexane, benzene and ether show the effect of the solvent in restricting the rotation of the polar molecules of the propyl alcohol. E. R.

**5039. Solvent Effect on Dipole Moments of Amines. E. G. Cowley and J. R. Partington.** *Chem. Soc., J. pp.* 1598–1601, *Oct.*, 1938.—The polarisations and moments of some amines in various solvents have been determined and the results considered in relation to the effect of the solvent. The variations observed between the measurements are small. Mention is made of the results obtained with certain other compounds which show a similar behaviour and a discussion of the influence of the solvent on these substances is given. [See also Abstract 3820 (1938).] AUTHORS.

**5040. Polymerisation of Styrolene in 50-Cycle Electric Fields and of Oil in Condensers. A. Liechti.** *Helv. Phys. Acta*, 11. 6. *pp.* 477–496, 1938. *In French.*—Oil employed for cable and condenser insulation undergoes a physico-chemical change resulting in the production of wax, or "x", which is a product of polymerisation. For paraffin, the reaction is described by $C_nH_{2n+2} + C_mH_{2m+2} = C_{n+m}H_{2(n+m)+2} + H_2$. The mechanism of polymerisation comprises (*a*) production of nuclei by activation of single molecules, rendering them susceptible to linking with similar molecules; (*b*) formation of chains without complete saturation of free valencies; (*c*) saturation of lateral free valencies. An experimental study on styrolene, under various maintained conditions of heat and d.c. and a.c. electric fields supports the hypothesis that polymerisation may occur without the presence of small air or gas pellicules being necessary at the commencement of the process, the observed presence of gas being the result of a secondary phase in the chemical action. M. G. S.

**5041. Dispersion and Absorption of Polar Substances. P. Debye and W. Ramm.** *N. Cimento*, 15. *pp.* 226–231, *April*, 1938. *In German.*—The paper is in the nature of a summary of recent work by Debye and his collaborators on polar liquids, *e.g.*, ethyl alcohol, with particular reference to their dispersion and absorption of electromagnetic waves of 2-100 cm. The bearing of the work on the theory of liquids is discussed. C. J. B. C.

**5042. Rôle of Solid Friction in Synthetic Dielectrics. A. Gemant.** *J. of Applied Physics*, 9. *pp.* 730–734, *Nov.*, 1938.—New synthetic dielectric materials, both of the ceramic and resinous type, exhibit, among other features, a high grade of homogeneity. This will not only affect favourably the mechanical properties, the electrical breakdown strength and the dielectric losses due to layer mechanism, but will also reduce losses due to dipole rotation. If, for example, dipolar constituents rotate at all in the solid state, dissipation of energy will be caused by the solid friction, which has to be overcome. This latter, on the other hand, can be shown to be related directly to the imperfections of the material, thus indicating the beneficial effect of a homogeneous structure on the dielectric loss angle. AUTHOR.

**5043. Comparison of Capacities at Radio Frequencies. W. Vaughan.** *Phil. Mag.* 26. *pp.* 521–557, *Oct.*, 1938.—Across the tuned grid circuit of a valve oscillator are connected two parallel branches, each consisting of a capacity ($C_a$ or $C_b$), and a resistance, ($R_a$ or $R_b$) in series. The capacities are the pair to be compared. $R_a$ and $R_b$ are made zero in turn, while the other resistance is adjusted so that the total admittance of tuned and shunt circuits is restored to the same value. Then $R_b/R_a = (C_a/C_b)^2$ provided $R^2C^2\omega^2 \ll 1$, where $\omega$ is the pulsatance. The behaviour of the circuit is discussed fully, and it is concluded that the method is capable of comparing capacities between 5 and 500 $\mu\mu$F at frequencies between 100 and 2000 kc./sec., with a consistency of 0·2 to 0·3%. Correction for stray capacity is not required. J. P. A.

**5044. Electrodynamic Volume and Porosity of Metallic Particles. H. Löwy.** *Phil. Mag.* 26. *pp.* 453–457, *Oct.*, 1938.—Expressions are derived for the electrodynamic volume and porosity of metallic particles dispersed in a dielectric, for cases in which the particles are assumed to be hollow bodies or bodies with a sponge-like structure. E. R.

*See also* Abstracts 5022, 5047, 5048.

## ELECTROCHEMISTRY.

**5045. Transport Numbers of Paraffin-Chain Salts in Aqueous Solution. Part II. G. S. Hartley. Part III. C. S. Samis and G. S. Hartley.** *Faraday Soc., Trans.* 34. *pp.* 1275–1305, *Nov.*, 1938.—In Part II the explanation of the changes in electrical mobilities with concentration in solutions of paraffin-chain salts in terms of micelles is reviewed. Certain objections to the micelle theory are examined. In Part III further measurements on conductivities and transport numbers of paraffin-chain salts in aqueous solutions are recorded. Transport measurements by the balanced boundary and Hittorf methods are compared. The qualitative generality of the changes in the equivalent conductivities (mobilities) with concentration is confirmed. When the gegenion associated with a given paraffin-chain ion is changed, changes in these conductivities are observed which must be due to changes not only in the fraction of the gegenions attached to the micelle but also in the size of the latter, and always in the direction that the greater the fraction attached the larger the micelle (and the lower the "critical" concentration). In determining these changes, specific properties of the gegenions are at least of equal importance to their valence. Thus the fraction of gegenions attached to, and the size of, the cetyl pyridinium micelle *decrease* in the order $I^- > Br^- > Cl^- >$ (Acetate)$^- > SO_4^=$, with (oxalate)$^=$ lying somewhere between $Br^-$ and $SO_4^=$. On the other hand for dodecyl sulphates the order is probably $Cu^{++} > Ag^+$. A correlation of this sequence with solubility of the salts in organic solvents is pointed out and a mechanism explaining it suggested. Degree of gegenion attachment and size vary in such a way that the micelle mobility (for a given paraffin-chain ion and concentration) appears to depend very little on the nature of the gegenion but very much on its valence, a fact which is very simply expressed, though not explained, in terms of the $\zeta$-potential. Measurements on mixtures with simple salts confirm the effect of the latter, indicated by comparison with diffusion measurements, in levelling-out these specific variations of size. Measurements on mixtures of cetyl pyridinium sulphate and chloride confirm that it is the latter, despite its lower valence, which is preferred by the micelle

for attachment to, or "solution" in, its outer layer. [For Part I, see Abstract 2852 (1936).] AUTHORS.

**5046. Glass Electrode in Alkaline Solutions. D. O. Jordan.** *Faraday Soc., Trans.* 34. *pp.* 1305–1310, *Nov.*, 1938.—The deviation of glass electrode potentials from perfect H-electrode potentials has been determined for alkaline solutions containing Na, Li, K, Ca, Sr and Ba ions at different pH values and ionic concentrations. An empirical relationship has been derived relating the glass electrode deviation, the pH as determined by the glass electrode and the ionic concentration. AUTHOR.

**5047. Capacity of Mercury Electrode in Solutions of Capillary-Active Organic Substances. A. Ksenofontov, M. Proskurnin and A. Gorodetzkaja.** *Acta Physicochimica*, 9. 1. *pp.* 39–44, 1938. *In English.*—Curves of Hg electrode capacity are obtained in solutions of capillary-active organic substances, and a physical interpretation of the shape of these curves is given. It is established that the minimum capacity in a saturated solution of a capillary-active organic substance decreases with an increase in the length of the chain in the organic molecule. AUTHORS.

**5048. Capacity of the Solid Mercury Electrode. A. Gorodetzkaja and M. Proskurnin.** *Acta Physicochimica*, 9. 1. *pp.* 45–50, 1938. *In English.*—It is shown by measurements of the capacity of solid and liquid Hg in an electrolyte solution and in the presence of a capillary-active substance that both the capacity per $cm^2$. of true surface area and the surface area of the Hg remain practically unchanged upon freezing. AUTHORS.

*See also* Abstracts 4770, 4827.

## ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

**5049. Determination of e/m from the Hα-Dα Interval. R. C. Williams.** *Phys. Rev.* 54. *pp.* 568–572, *Oct.* 15, 1938.—Photographs were taken with a 3 mm. étalon of the interference pattern of Hα and Dα from a discharge in the two gases mixed in equal proportions. The interval between the intensity peaks due to the low frequency major components of the two isotopes was measured with the microphotometer used as a comparator. Corrections were made to the observed positions of the intensity peaks to change them to the positions of the centres of the components. These corrections were based on the intensities, positions, and half-intensity breadths of the components as experimentally determined, and upon certain assumptions relative to the shape of the components. An interval between components of $4 \cdot 14700 \pm 0 \cdot 0004$ $cm^{-1}$., when reduced to vacuum, was obtained. By combining this with recently determined values of the atomic weights of H and D as reported by Livingston and Bethe, the wave number of Hα as determined by Houston, and the physical Faraday as computed by Birge, a value of $1 \cdot 7579 \pm 0 \cdot 0004 \times 10^7$ e.m.u./gm. is obtained for the value of $e/m$. [See Abstract 4933 (1938).] AUTHOR.

**5050. Determination of e/m from Refraction of X-Rays in a Diamond Prism. J. A. Bearden.** *Phys. Rev.* 54. *pp.* 698–704, *Nov.* 1, 1938.—Measurements of the index of refraction of the $CuK_\beta$ line by a diamond prism have been made with an estimated accuracy of one part in 10,000. These measurements together with the quantum theory of dispersion and the ruled grating wave-length of the $CuK_\beta$ line afford a method of evaluating $e/m$ with an accuracy comparable to that of previous determinations by other methods. The value of $e/m$ is given by the equation $e/m = \delta[(\lambda^2 \rho F/2\pi W) \Sigma_1^s N_s(1 + A)]^{-1}$,

where $\delta$, $\lambda$, $\rho$, $F$, $N_s$ and $W$ have their usual meaning and $A$ is the factor which takes into account the electronic binding. For C and a $\lambda^{2\cdot75}$ law of absorption, the value of the $\Sigma_1^s = 6\cdot0163 \pm 0\cdot0006$. Using $\delta = 9224\cdot4 \times 10^{-9}$, $W = 12\cdot0148$, $\rho = 3\cdot5154$, $F = 96513\cdot1$, $\lambda = 1\cdot39220$ Å, one obtains $e/m = (1\cdot7601 \pm 0\cdot0003) \times 10^7$ e.m.u. This bound electron value is higher than most previous spectroscopic determinations but is in excellent agreement with the free electron results of Dunnington [see Abstract 5453 (1937)]. AUTHOR.

**5051. Electron-Optical Investigation of the Passage of Slow Electrons (0-200V) through Metal Foil. H. Katz.** *Ann. d. Physik*, 33. 2. *pp.* 160–168, *Sept.*, 1938.—Investigation of the electron diffraction patterns obtained with Ag foil using secondary electrons gave the quite unexpected result that slow electrons can pass in very considerable numbers through chemically deposited Ag foil. The permeability is equally great over the whole surface and can be observed even for electron velocities very close to zero voltage. With electrons of low velocity (of the order of 10 V) electron images can be obtained through the foil of objects placed in the path of the beam, thus showing that the electrons pass through the foil without any marked change of direction. At higher electron velocities the electron images obtained indicate that the electrons after passage through the foil have velocities which fall into two groups. Foils produced in other ways and with other materials show weaker permeability than chemically deposited foils. The permeability is also lower after long exposure to the electron stream. [See following Abstract.] A. W.

**5052. Passage of Slow Electrons (0-200 V) through Metal Foil. H. Katz.** *Ann. d. Physik*, 33. 2. *pp.* 169–184, *Sept.*, 1938.—Ag foil deposited chemically on glass has a surprisingly high transmission value for slow electrons [see preceding Abstract]. The permeability is affected by the previous treatment to which the foil has been subjected. It is found that the transmitted electrons are divided into two well defined groups, one having velocities of only a few volts (secondary electrons), while in the other group the electrons have nearly their original velocity. The "free" permeability, *i.e.*, the fraction of the electrons passing through the foil without energy loss or change of direction, passes through a maximum as the electron velocity is increased. The different behaviour of the total permeability for different foils can be explained by their different behaviour as regards the free permeability. From the existence of a minimum of the free permeability at an electron velocity of a few hundred volts it is concluded that there is a corresponding maximum of the emission of secondary electrons. A. W.

**5053. Straggling of Electrons due to Radiation and Ionisation Loss. H. C. Corben.** *Cambridge Phil. Soc., Proc.* 34. *pp.* 540–549, *Oct.*, 1938.—The probability of an electron having an energy greater than a certain fraction of its initial energy after traversing a certain thickness of matter is calculated for different values of the initial energy. Whereas in previous calculations the energy losses by radiation and by ionisation have been treated separately, and the results added, the two types of losses are here combined and their effect on each other included. The results may be compared with those of experiment for values of the initial energy up to a few times the critical energy of the substance traversed. The theoretical values obtained are found to give better agreement with the results of experiment than do those obtained by the less accurate method. AUTHOR.

**5054. Slowing Down of Neutrons in a Proton Gas. K. Husimi.** *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 780–792, *Sept.*, 1938.—This paper deals with a gas kinetic calculation of the process of slowing down a group of neutrons in a gas of protons having a Maxwellian energy distribution. The energy distribution of neutrons in the stationary state is established by assuming a constant source of neutrons with a prescribed energy distribution and a finite capture probability. The primary purpose of the investigation is to clarify the question of how far the naïve exception of neutrons being clarified into fast and thermal groups can be maintained from the more rational gas formalism. The calculation is a direct extension of the pioneer work of Fermi, whereby the latter's treatment of static protons is altered to one in which the protons are subjected to thermal agitation. H. H. Ho.

***5055. Production of Collimated Beams of Monochromatic Neutrons in the Temperature Range 300°-10° K. L. W. Alvarez.** *Phys. Rev.* 54. *pp.* 609–617, *Oct.* 15, 1938.—An electrical velocity selector is described, which allows the production and use of highly collimated beams of pure thermal neutrons. The mean temperature of the neutrons may be varied from 300° K. to an undetermined lower limit, probably less than 10°K., without the use of refrigerants. The temperature width of the neutron "line" is also adjustable. Fast neutron effects are completely eliminated. Qualitative verification of the $1/v$ law for B has been extended to 30° K. The intensity of neutrons available from the cyclotron allows counting rates of 1000 per min. to be obtained at 30° K., with a source-detector distance of 4 m., and an angular spread of 1°.

AUTHOR.

**5056. Secondary Electron Emission of Beryllium. R. Kollath.** *Ann. d. Physik*, 33. 4. *pp.* 285–299, *Oct.*, 1938.—The secondary emission of Be was investigated under widely differing conditions of experiment. Sheets exhausted in high vacuum give a very small output (max. $0{\cdot}4_2$). Compact Be plates exhibit a yield about ten times as great (max. 4–5). Oxidation of the sheets treated *in vacuo* in a glow discharge in $O_2$ lead to the highest output of 2 to $2{\cdot}5$. Oxidation in an atmosphere of $O_2$ with simultaneous heating yields after a long time (dependent on the pressure of $O_2$) a maximum output of 4–5. On glowing exhausted sheets in as high a vacuum as possible a rise in the output occurs if a definite temperature is attained which lies in the region of 700–800° C. The conclusion is reached that, at any rate for Be, oxidation alone does not lead to the highest obtainable output, but that additional processes in the sheet are necessary which are connected with the arrangement of the atoms in the sheet. J. J. S.

**5057. Secondary Electron Emission from Wire Gauze. M. Sandhagen.** *Zeits. f. Physik*, 110. 9–10. *pp.* 553–572, 1938.—Investigations were made of the output and distribution of the secondary electrons released by a beam of primary electrons from a fine-meshed wire gauze located between two annular discs 8 mm. apart maintained at potentials variable with respect to one another and to the gauze. By variation of the gauze diameter the effects of the suction and retarding fields on the paths of the secondary electrons were separated from one another. For the types of reflector nets commonly used in the valve industry the efficiency was found to be nearly constant and independent of the wire material, but small in comparison with that of a massive plate. On this account

the possibility is suggested of utilising small plates instead of gauze for secondary electron multiplication. A. W.

*See also* Abstracts 4893, 4901, 4906, 5026 and
3416B. Symmetry Problem of Braun Tubes. H. Pieplow and E. Steudel.
3417B. Spherical Aberration of Magnetic Lenses. H. Becher and A. Wallraff.
3418B. Optics of Electric Charges. P. Bricout.

## ELECTROSTATICS.

**5058. Contact P.D. between Ba and Mg. P. A. Anderson.** *Phys. Rev.* 54. *pp.* 753–757, *Nov.* 1, 1938.—With the purpose of subjecting the electronic method of contact potential measurement to a thorough test for consistency with independent photoelectric work function determinations, the Volta potential Ba-Mg has been measured for some 30 pairs of surfaces and the results compared with recent careful photoelectric studies of these metals. Each surface was prepared by fractionally distilling the metal in a gettered vacuum and revaporising a middle fraction to form a thick film on glass at room-temperature. Each film was measured a few seconds after deposition and tubes of two different designs used to minimise the possibility of errors originating in tube geometry. The majority of the observed Volta potentials fell within the range of values predicted by the photoelectric data, 1·08–1·16 V, and no values below this range were found. The Mg films were largely responsible for variations in the Volta potential and a few gave potential settings sufficiently low (work functions sufficiently high) to raise the observed Volta potentials to a maximum of 1·26 V. Since all probable contaminations should lower the work function the maximum value is regarded as the most reliable. Assuming a work function of 2·52 eV for Ba this gives 3·78 eV for the work function of Mg. Observations on the optical reflection of the Mg surfaces suggest, however, that a work function of $3{\cdot}65 \pm 0{\cdot}05$ eV may be characteristic of mirror-like surfaces of the metal; 3·78 eV of macrocrystalline (matte) surfaces. AUTHOR.

*See also* Abstract 4899.

## MAGNETISM AND ELECTROMAGNETISM.

**5059. Paramagnetism of Mn. A. Serres.** *J. de Physique et le Radium*, 9. *pp.* 377–380, *Sept.*, 1938.—The effect of temperature on the paramagnetism of crystallised Mn has been investigated. In contradiction to the theory proposed by Néel [see Abstract 1874 (1936)] the paramagnetism decreases slowly but continuously with increasing temperature in the range —183° to +600°. At lower temperatures the magnetisation passes through a minimum, whilst at higher temperatures it tends to a maximum above 600°, probably at the temperature of the $\alpha \rightarrow \beta$ transformation. No anomaly in the paramagnetism has been found near 350° to correspond with the observed anomaly in the specific heat. W. R. A.

**5060. Paramagnetic Dispersion in a Single Crystal. P. Teunissen and C. J. Gorter.** *Physica*, 5. *pp.* 855–856, *Oct.*, 1938. *In English.*—Paramagnetic dispersion in a crystal of ferric alum is isotropic with respect to the orientation of the crystal axes. [See also Abstracts 3403 and 4244 (1937).] AUTHORS.

**5061. Suitability of Diamagnetic Crystal for Magnetic Field Measurement. R. G. Stansfield.** *Cambridge Phil. Soc., Proc.* 34. *pp.* 625–633, *Oct.*, 1938.—The magnetic anisotropy of crystals of calcite

and sodium nitrate does not alter between room-temperature and liquid nitrogen temperature. Using such diamagnetic crystals, it is easy to compare strong magnetic fields to 1 part in 1000. The effect is large enough for the measurement of fields of the order of 100 gauss, but in small fields the accuracy is limited by ferromagnetic contamination.

AUTHOR.

***5062. Method for Obtaining a Uniform Magnetic Field. J. W. Clark.** *Rev. Sci. Instruments*, 9. *pp.* 320–322, *Oct.*, 1938.—Describes the design and construction of a coil, wound on a hollow wooden sphere or ellipsoid and distributed so that the number of turns per unit of axial length is constant, which provides a field uniform within 1% over a large part of the volume enclosed. Uniform fields of the order of hundreds of oersteds (or, by the use of special cooling, a few thousand oersteds) can be obtained by this method more cheaply than by means of iron-cored magnets, and with much greater uniformity perpendicular to the lines of force than by means of Helmholtz coils. C. E. W.

***5063. Simple Magnetometer for Moderate to Very Strong Fields. A. Deubner.** *Phys. Zeits.* 39. *pp.* 716–718, *Oct.* 15, 1938.—A small, soft iron rod is mounted perpendicular to and at one end of a spindle, which is attached through a spring to a turning-head. The torque on the rod due to the field to be measured is balanced by means of the head, the rotation of which gives a measure of the field-strength. . The instrument is set with the rod in the position of maximum torque (at 45° to the field). A lower limit of field-strength measurable occurs where the field becomes comparable with the coercive force of the soft iron, but by suitable choice of rod dimensions and strength of spring, any field-strength greater than a few oersteds can be measured with an accuracy claimed to approach 1 part in 1000. C. E. W.

***5064. Portable Direct-Reading Magnetometer. G. L. Turney and G. E. Cousins.** *Journ. Sci. Instruments*, 15. *pp.* 360–367, *Nov.*, 1938.—A portable magnetometer using a "null" method is described. The balance indication depends on the variation of the a.c. resistance of a high permeability mumetal wire in an external magnetic field. AUTHORS.

*See also* Abstracts 5031, 5074 and
3428B. Parameters of Surface Orthogonal to Eddying Magnetic Fields. T. Lehmann.
3434B. Design of Large Electromagnets. L. Dreyfus.

## MEDICAL RADIOLOGY AND ELECTROLOGY.

**5065. Bioelectric Phenomena of the Nervous System and Their Possible Application to Medicine. A. Baudouin and H. Fischgold.** *J. de Radiologie et d'Électrologie*, 22. *pp.* 401–428, *Sept.*, 1938.—The phenomena of electrical changes in the nervous system are complex and a general review is given in the present paper, commencing from the early researches of Matteucci in 1840 and dealing with the difficulties of isolated research of muscular and nervous tissue. The basic principles of measurement of currents generated in nerves by their lesion or physiological action are detailed and then practical examinations of muscular, peripheral nerve and sympathetic nerves are discussed with illustrative instrumental readings. Further, more recent work in respect to brain tissue in various regions of the brain is dealt with at some length, particularly in respect to the electroencephalogram of Berger used in respect to the human brain, the electrodes being described in detail, with close discussion

of the various types of record curves obtained under various conditions such as with drugs, alcohol and ether. The electrical variations in epilepsy which have been demonstrated by Berger are described and the electrical signs which assist diagnosis of this condition. The authors are of opinion that this method of investigation opens up a wide field of medical research and further practical clinical applications. B. J. L.

**5066. Secondary Electromotive Phenomena of Nerve Tissue. A. Strohl and A. Djourno.** *J. de Radiologie et d'Électrologie*, 22. *pp.* 481–489, *Oct.*, 1938.—Passage of d.c. *via* a segment of nerve tissue results in a distribution of potential in accordance with the electrotonic current. When this current is interrupted the potentials do not immediately revert to their initial value, there being a time lag which is considered to be due to secondary electromotive phenomena. This effect is studied by the authors in respect to current between conductive electrodes, the apparatus being described with galvanometer readings obtained by use of normal nerve, aged nerve tissue and nerve tissue submitted to the action of ether. The distribution of the secondary potential along the nerve is separately discussed. The phenomena are thought to originate from depolarisation effects. B. J. L.

***5067. Differential Amplifier for Electrophysiology and for Bridge Measurements. H. König.** *Helv. Phys. Acta*, 11. 6. *pp.* 507–512, 1938. *In German.*—A circuit without magnetic coupling which amplifies the p.d. between two electrodes independently of their absolute potential is described. The input voltages are fed through two valves in parallel to a 1- or 2-valve amplifier, giving an output circuit with one pole earthed. The amplifier can be used directly or in combination with a bridge circuit for electrophysiological measurements. The characteristics of the amplifier over a wide range of frequencies and for single impulses have been investigated. J. E. R.

**5068. Radiographic Detail. F. Bettelheim.** *Am. J. of Roentgenology and Radium Therapy*, 40. *pp.* 401–404, *Sept.*, 1938.—Reference is made to the fact that many radiographs taken after the discovery of X-rays 42 years ago compare, in respect to the visual impression, very favourably with modern radiographs. The photographic effect is dependent upon the absorption of the tissue radiographed. Whereas electroscopic measurements and mathematical calculations of the absorption of various human tissues would predict a radiographic differentiation of tissues, particularly in respect to soft tissues, in practice this is not the case. The three main factors are (1) composition of the X-ray beam, (2) the body tissues, and (3) the photosensitive layer. These various factors are discussed in detail and improvement in differentiation is considered to be obtainable by working with monochromatic radiation characteristic of a suitable anode material, choosing the longest wave-length suitable for the problem in question, using photosensitive material absorbing the remainder of the radiation spectrum, increasing the focus-object distance to reduce scattered radiation and non-use of intensifying screens. Experiments are being undertaken to prove or disprove these conclusions. B. J. L.

**5069. Mechanism of Delayed Killing of Maize Seeds by X-Rays. L. R. Maxwell.** *Nat. Acad. Sci., Proc.* 24. *pp.* 377–384, *Sept.*, 1938.—Biological response to X-rays has often been interpreted on the basis of the quantum theory of radiation absorption and the so-called hit theory of Glocker [see Abstract 792 (1933)], involving the concept of a particular sensitive volume within the material. The survival-dosage curves for

single-celled individuals frequently show a simple exponential relationship. When multi-cellular systems are studied it is usually found that the survival curves have a sigmoid shape, indicating that either death occurs from a number of hits within one sensitive volume or a different number of hits within two or more sensitive volumes. This theory has been tested for corn seed embryos which are 7 mm. long, large enough for scanning purposes designed for the purpose of searching for the position of a possible single sensitive volume. A continuous band of radiation was used with a maximum intensity at 0·50 Å and a short wave-length limit of 0·26 Å with dosages ranging up to 300,000 röntgens, and scanning irradiation zones of 0·5-3·0 mm. width, defined by Pb plates. Experimental survival-ratio dosage relationships are shown, in which a sigmoid-shaped curve is obtained. A theoretical survival curve was made to fit the experimental curve by selecting 14 to be the number of penetrations by primary electrons and the spherical sensitive volume to be approximately $1 \times 10^{-15}$ cm$^3$. on the basis of the use of monochromatic radiation of wave-length 0·50 Å which approximates to the average wave-length used. From a series of experiments it is concluded that if multiple sensitive volumes do exist, they are not contained within a spherical volume whose diameter is less than 0·5 mm. T. A. C.

**5070. Radiation Protection. R. Jaeger and H. Stubbe.** *Phys. Zeits.* 39. *pp.* 671–673, *Oct.* 1, 1938. *From the Reichsanstalt.*—In view of the now well established facts that the effects of X- and $\gamma$-rays on mutation rates are cumulative and irreversible, the question of the protection of medical and industrial radiologists is reviewed. The use of condenser ionisation chambers which can be carried by radiation workers, is advocated for protection purposes. The characteristics of the air-wall condenser chambers of Zimmer, which are suitable for this purpose, have been investigated. It is pointed out that a dose of 100 r. will double or treble the spontaneous mutation rate of *Drosophila melanogaster*. Workers subjected to the accepted tolerance dose rate of 0·25 r./day, would receive this dose in approximately 2 years, and it is suggested that the cumulative dose in a working life may be too large. Investigations have been carried out in a number of radiological institutions, and in some cases the daily dose received by workers was only 1/10 of the tolerance dose of 0·25 r./day. J. E. R.

***5071. Depth Doses from Teleradium Units. W. V. Mayneord and J. Honeyburne.** *Brit. J. of Radiology*, 11. *pp.* 741–753, *Nov.*, 1938. —An experimental teleradium unit is described, in which it is arranged that focal " skin " distance, thickness of filter and area of source, may be varied. It is shown experimentally that the amount of soft radiation at the aperture increases with focal " skin " distance, as does the percentage depth dose. Results of experiments with varying thicknesses of lead filter show that the first 0·5 mm. of lead, together with 0·6 mm. brass, produce the maximum improvement in depth dose. Varying the area of the source produces little difference in depth dose for large focal " skin " distances, but for smaller ones (2–3 cm.) increases the depth dose by some 20%. AUTHORS.

***5072. Dosage with Radium Surface Applicators of Small Area. J. E. Roberts.** *Brit. J. of Radiology*, 11. *pp.* 755–761, *Nov.*, 1938.—A number of physical problems which arise in the use of Ra surface applicators of small area are considered from the point of view of radium and radiation distribution. Depth dose curves show the advantages of the use of larger

Ra skin distances, the improvement being particularly marked at the edge of the applicator. The effects of errors in Ra distribution and Ra skin distance are indicated. With a view to overcoming some of the difficulties, specifications of a number of standard small applicators are given. AUTHOR.

***5073. Two-Gramme Radium Unit. F. L. Warburton.** *Brit. J. of Radiology*, 11. *pp.* 762–766, *Nov.*, 1938.—A description is given of a new appliance for the use of a 2 gm. Ra unit constructed largely of W-alloy. The unit is extremely flexible. Protection for the staff is provided by shutting off the beam in the unit itself when not in use. AUTHOR.

*See also* Abstract 4900.

## OSCILLATIONS AND WAVES.

**5074. Velocity of Propagation of Electric Waves along Nickel Wires and Magnetic Permeability of Nickel for Hertzian Oscillations. K. F. Lindman.** *Zeits. f. techn. Physik*, 19. 10. *pp.* 323–324, 1938.—The difference between the velocity of light and the velocity of propagation of electric waves along Ni wires of 0·0172 mm. dia. is measured for wave-lengths from 15·8 to 86 cm. As the wave-length is increased up to about 50 cm. the difference rapidly increases but then approaches a constant difference of about 25000 km./sec., corresponding to a permeability of 19·9. The value for Fe at the same wave-length is about 100. [See also Abstract 3418 (1938).] H. J. H. S.

**5075. Physics of the Upper Atmosphere. J. Zenneck.** *Gerlands Beitr. z. Geophys., Supplementband* 3. *pp.* 1–37, 1938.—Review and Bibliography of the subject.

**5076. Study of Magneto-Ionic Theory of Wave Propagation by Means of Simple Formulæ, Linkages and Graphical Devices. V. A. Bailey and J. M. Somerville.** *Phil. Mag.* 26. *pp.* 888–905, *Nov.*, 1938. *Supplement.*—Methods are given for the rapid numerical determination of the polarisation R, refractive index $\mu$, and absorption index $\chi$ of an electric wave in an ionised gaseous medium with a constant magnetic field present (*e.g.*, the ionosphere). First is given a scheme for the arithmetical computation of R, $\mu$ and $\chi$. Next a simple linkage is described by means of which R can be determined in two settings. Finally it is shown how, when R is known, $\mu$ and $\chi$ can be determined by any one of the following means : (1) A special linkage ; (2) a chart containing two families of circles and (say) three parabolæ ; (3) a chart containing three families of circles. AUTHORS.

**5077. Damping Coupling. G. Schmerwitz.** *Ann. d. Physik*, 33. 2. *pp.* 107–108, *Sept.*, 1938.—The author refers to a previous paper [see Abstract 4906 (1937)] and to papers of K. W. Wagner on the same subject. He points out the differences between the cases taken by Wagner and that considered by himself. H. H. H.

*See also* Abstract 4849 and

3409B. Wavemeter. Y. Miyamura.
3575B. Unusual Range of Radio Signals. J. A. Pierce and H. R. Mimno.
3576B. Reflection Coefficients of Heaviside Layer. F. Vilbig.
3578B. Radio Transmission and Solar Activity. E. V. Appleton.
3589B. Forced Oscillations. F. Dacos.
3590B. Relaxation Oscillations. J. J. Muller.
3596B. Barkhausen Oscillations of Double Frequency. H. Mohr.

## PHOTOELECTRICITY.

**5078. Optical Properties and Photoelectric Emission in Thin Alkali Metal Films. H. E. Ives and H. B. Briggs.** *J.O.S.A.* 28. *pp.* 330–338, *Sept.*, 1938.—Details are given of an experimental investigation undertaken to test a theory correlating the photoelectric emission of thin films of alkali metals with the optical properties of the alkali metals and the base on which they are deposited. The theory assumes that the photoelectric emission is proportional to the rate of absorption of energy in the top layer of the alkali metal film and when extended gives close agreement with experiment. The characteristic phenomena, *i.e.*, emission maxima occurring in the spectral response curves of photoelectric emission appearing only for light polarised in one plane, are explained in terms of the optical constants. A. H.

***5079. Accuracy of Rectifier-Photoelectric Cells. J. R. Atkinson. N. R. Campbell, E. H. Palmer and G. T. Winch.** *Phys. Soc., Proc.* 50, *pp.* 934–946, *Nov.* 1, 1938.—The effect of a resistance R in series with a rectifier-photo-cell on (*a*) the linearity of the response and (*b*) the temperature coefficient of the sensitivity has been investigated. In order that no restriction should be imposed on R by the effective sensitivity, the photoelectric current was measured by compensation. The light sources used in these experiments were tungsten-filament vacuum lamps operating at a colour temperature of approximately 2400° K. The temperature coefficient of the cell is always least when R = 0, but is not then generally zero. The approach to linearity is generally closest for a finite value of R which is usually between 100 and 1000 Ω. But no value of R will avoid errors of 1% if linearity is assumed over a range of 0 to 240 lux. The observations can be explained qualitatively, but not completely, by assuming the presence of a series resistance inside the cell in addition to the shunt resistance. These two resistances do not vary in the same manner with temperature and with illumination. Some practical conclusions are given in the final paragraph. AUTHORS.

*See also* Abstracts 4971, 5058.

## PIEZOELECTRICITY.

**5080. Survey of Piezoelectricity. W. G. Cady.** *Am. Phys. Teacher*, 6. *pp.* 227–242, *Oct.*, 1938.—Gives the early history of the development of piezoelectricity. Mentions modern applications such as the piezoelectric resonator and oscillator. H. H. H.

**5081. Anomalous Charging Current in Rochelle-Salt Crystals. F. Seidl.** *Phys. Zeits.* 39. *pp.* 714–716, *Oct.* 15, 1938.—The anomalous charging current in Rochelle-salt crystals follows a law of the form $I(t) = k \cdot t^{-m}$ for short intervals of time $t$ within the experimental limits of 2·6 – 8·1 m.sec., the value of $m$ being unity. For times of voltage application shorter than 2·6 m.sec. there is some divergence from this relation. Over the same interval, the current/voltage relation is linear, *i.e.*, in accordance with Ohm's law. The initial current depends on the thickness of the specimen. M. G. S.

## THERMIONICS.

*See* Abstracts 5056, 5057.